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Letter Report

Hydrogeologic Assessment

D'APPOLONIA

Project No. 83-1676
Jan 84

D'APPOLONIA
WASTE MANAGEMENT SERVICES

Letter Report

Hydrogeologic Assessment

East St. Louis Site
East St. Louis, Illinois

Allied Chemical Co.
East St. Louis, Illinois

D'APPOLONIA

WASTE MANAGEMENT SERVICES

January 9, 1984

Project No. 83-1676

Mr. S. K. Shogren
Supervisor - Environmental
Central Region
Allied Chemical Company
Route 3, Box 26
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Transmittal
Letter Report
Hydrogeologic Assessment
East St. Louis, Illinois

Dear Mr. Shogren:

D'Appolonia Waste Management Services, Inc. (D'Appolonia), was retained by Allied Chemical Company (Allied) to conduct a hydrogeologic assessment at the East St. Louis, Illinois works relative to the potential for ground water contamination beneath the plant site. Allied has operated an aluminum sulfate and sodium aluminum sulfate manufacturing facility on this site since 1912. A sulfuric acid production facility was operated on a portion of the site from 1926 until 1973 when it was shut down and dismantled. A phosphoric acid plant was also operational on site from 1961 through 1969. It has also been dismantled. The site is located in Fairmont City, Canteen Township, St. Clair County, Illinois. The remainder of this report contains an introduction, the field and laboratory program methodologies, discussion of results, and conclusions of the assessment.

INTRODUCTION

D'Appolonia was retained to conduct a hydrogeologic assessment in order for Allied to achieve compliance with special conditions contained in the plant's Water Pollution Control Permit as issued by the Illinois Environmental Protection Agency (IEPA). This permit gives Allied conditional approval to operate a closed-circuit settling lagoon to separate residual solids from the aluminum sulfate plant wastewater. The lagoon covers approximately four acres and can be seen in the upper center of the easternmost portion of Figure 1. As part of IEPA's conditional permit approval, Allied must submit to IEPA the results of a hydrogeologic study designed to evaluate apparent site contamination, including the results of analysis of ground water samples obtained from monitoring

wells both upgradient and downgradient of the lagoon. D'Appolonia's investigations were designed primarily to address these concerns of the IEPA and, specifically, the following objectives:

- Define the direction(s) of ground water flow beneath the plant property.
- Determine the influence of the plant production well on the local hydrogeologic regime.
- Define the stratigraphy of the unconsolidated deposits underlying the plant property and determine whether a stratified aquifer condition exists.
- Determine the potential for ground water contamination originating off site to migrate toward the plant property and recommend appropriate monitoring well locations.
- Design and install an appropriate ground water monitoring network to include at least one well upgradient and one well downgradient of the active alum residue pond.
- Provide services to sample and analyze each monitor well once by U.S. EPA approved methods.

METHODOLOGY

FIELD PROGRAM

Soil Borings

A drilling rig mounted on an all-terrain vehicle was mobilized to the site September 6, 1983 and drilling began the following day on deep soil Boring B-1, located in the eastern limits of the old alum residue pond area (Figure 1). This boring was completed in approximately 1-1/2 days. Work then began on soil Boring B-2, which was located immediately east of the employee parking area. Boring logs for both borings are included in Appendix A. In each boring, hollow stem augers were used to advance the boring through the water table. Due to the limited depth capability of hollow stem augers, mud rotary techniques were utilized below this depth in order to assure the boring would stay open in the coarse-grained deposits in which ground water flow occurs.

Samples were obtained at 2.5-foot intervals (distance between the tops of sampling drives) in both borings from 0 (ground surface) to 60 feet,

and at 10-foot intervals thereafter to bedrock. Sampling methodology consisted of driving a standard split-spoon sampler 18 inches with a 140-pound hammer falling 30 inches. The number of hammer blows required to drive the sampler per each 6-inch interval was recorded on the boring log, and a visual description of each sample prepared in the field as part of the boring log.

The original scope of work stated three deep borings were to be completed on site. The third boring was deleted from the program after consultation with Allied. The stratigraphy observed in Borings B-1 and B-2 was very similar, even though they were drilled at opposite ends of the site. It was decided that a third boring located approximately halfway between B-1 and B-2 was unnecessary due to the lack of any fine-grained sediments (confining layers) found in the aquifer as observed in B-1 and B-2. Undetected fine-grained sediments underlying the site, if any, are areally discontinuous and would not be effective in preventing the downward migration of ground water.

Piezometer Installation

The original scope of work included installation of seven piezometers on the site. One additional piezometer was installed in lieu of the third soil boring at the request of Allied. This additional piezometer was placed adjacent to the eastern edge of the employee parking area and is designated PZ-1. The locations of all eight piezometers are shown in Figure 1.

Hollow stem augers were used to advance a 4.5-inch-diameter hole into the aquifer. Samples were taken with a split-spoon sampler to identify the depth at which the aquifer (sand) was encountered. These samples were normally taken whenever the driller noted a change in downhole pressure or whenever ground water was encountered. Samples of the materials in which the piezometer screens were installed (sensing zone) were collected for grain-size analysis.

Piezometers were constructed of threaded, flush-joint Schedule 40 polyvinyl chloride (PVC) pipe with a 2-inch inside diameter (ID). A section of slotted PVC screen, approximately 10 feet long, was installed at the bottom of each piezometer to act as the sensing zone. A screen slot size of 0.006 inch was selected to minimize the collection of silt in the well.

Once the augers encountered ground water, the boring was continued to such a depth that the piezometer screen could be installed entirely in coarse-grained deposits, while also insuring that the screen was placed at least five feet into the water table. A flat, threaded plug was placed in the bottom of each piezometer to keep coarse-grained materials from migrating up inside the screen. The threaded sections of PVC were

installed through the augers, followed by a gravel pack around the screened interval. The augers were gradually pulled from the boring as the gravel pack was advanced to make sure the hole stayed open. The gravel pack was typically extended above the depth at which sand was encountered. In all piezometers except PZ-1 and PZ-2, a layer of sand approximately one foot thick was placed on top of the gravel pack to act as a barrier between the gravel pack and the cement-bentonite grout. In Piezometers PZ-1 and PZ-2, a very thick bentonite slurry was mixed and placed as a seal on top of the gravel pack. The remainder of the annulus in each boring was grouted through the augers to ground surface with a cement-bentonite slurry as the augers were gradually pulled from the boring. A threaded plastic cap was placed on the top of each riser pipe. Metal protective casings with locking caps were cemented into place around the top of the piezometers to protect the riser pipes. Upon completion, a site survey was conducted to obtain elevations of the top of the riser pipe at each piezometer to use as a reference point in obtaining ground water levels. Surveying was conducted by Lopinot & Weber, Inc., of St. Louis. Reference datum was obtained from the Illinois Department of Transportation and utilized a point on the railyard overpass on Kingshighway near the plant entrance.

Sensitivity Testing

Sensitivity tests were conducted in all piezometers upon completion to assure proper communication between the piezometer and the aquifer. Each piezometer was first flushed completely by blowing out standing water with compressed air. Ground water levels recovered rapidly in all piezometers following development.

Sensitivity tests were conducted by filling the standpipes with water and measuring the rate at which the water level fell in the standpipe as a function of time. Water level measurements were made for several minutes until the level stabilized, indicating an equilibrium condition with the ground water level had been obtained. In a properly functioning open piezometer, the time required for stabilization of the piezometer head depends upon the permeability of the formation surrounding the well point. Using the change in water level measured as a function of time, the permeability of the aquifer was calculated at each piezometer location. The aquifer permeability at Piezometers PZ-6, PZ-7, and PZ-8 is great enough that the standpipes could not be filled with water during the tests.

Plant Production Well

As part of the site investigation, D'Appolonia evaluated the influence of the plant production well on the local hydrogeologic regime. This well was installed to a depth of 110 feet in 1973 and screened from 85 to 110 feet. The well has 48-inch casing from ground surface to 80 feet

and 36-inch casing from 80 to 110 feet. The pump was originally installed at 100 feet and later raised to its present depth of 80 feet. Measurements of the pump discharge rate were provided by Allied, as were records detailing the periods of pump operation over the past two years. D'Appolonia obtained water level measurements in the production well during pumping and nonpumping periods. Samples obtained during piezometer and soil boring installation allowed for evaluation of aquifer materials.

LABORATORY PROGRAM

Ground Water Analysis

Ground water levels were measured in the piezometers prior to development and samples were obtained for analysis after bailing each piezometer. Samples for dissolved metals analysis were filtered through a 0.45 micron filter membrane upon collection. Samples were properly preserved and transported to D'Appolonia's laboratory for analysis according to U.S. EPA approved methods. Allied was also provided with a split of these samples. The parameters selected for analysis were those specified by the IEPA in the special conditions appended to Allied's permit:

- pH (measured in the field)
- Total dissolved solids
- Sulfate (SO_4)
- Dissolved iron
- Dissolved manganese
- Oil and grease.

Additionally, specific conductance and water temperature were measured in the field at the time of sample collection.

Grain-Size Analysis

Six samples of the coarse-grained deposits (primarily sand) obtained from the aquifer were selected for analysis of grain-size distribution. The analysis consists of passing each sample through a series of progressively smaller sieves with the percentage of sample retained on each sieve determined and plotted. This information was used to better define aquifer conditions and to assure that proper piezometer construction techniques had been utilized.

RESULTS AND DISCUSSION

SITE STRATIGRAPHY

The regional site setting is the American Bottoms area of the Mississippi River Valley. This area is underlain by approximately 80 to 140 feet of alluvial material (old river channel deposits). The deeper deposits yield large quantities of water to municipal and industrial wells and East St. Louis is historically a heavily pumped area. The plant site lies toward the eastern edge of the American Bottoms area. The normal direction of ground water flow (north to south) has historically been altered by the heavy pumpage (east to west). High mineral content, generally associated with the deeper alluvial deposits and inflow from bedrock ground water, has historically been a problem for large ground water users in the American Bottoms area.

The two stratigraphic borings (B-1 and B-2) revealed the site is underlain by an unconfined aquifer, lacking any continuous fine-grained stratifying or confining layers. The boring logs, attached as Appendix A, indicate the aquifer consists primarily of fine- to medium-grained sand lying in a deposit approximately 100 feet thick over bedrock. Water levels encountered in these two borings were 2 to 5 feet below the top of the sand deposits.

Boring B-1 was located within an old alum pond site in the eastern portion of the property immediately west of the active lagoon. Alum residues were encountered to 19.5 feet below present ground surface. A six-foot-thick clay to silty clay soil layer was encountered in B-1 from approximately 19.5- to 25.5-foot depth. Fine- to medium-grained sand deposits began at 25.5 feet below ground surface and continued to the top of bedrock at 127.5 feet.

Boring B-2 was located in the western portion of the property in the center of what used to be the sulfuric acid plant area. This boring revealed coarse, cinder-like materials with a detectable sulfurous odor from the ground surface to a 7-foot depth. Clayey silt and other clayey materials, similar to that layer encountered in Boring B-1, were encountered from the 7- to 16.3-foot depths. Fine- to medium-grained sand was encountered from 16.3 feet to the top of bedrock at 118 feet below ground surface.

Figure 2 presents a generalized profile of site stratigraphy based on the data obtained from Borings B-1 and B-2. The cross section shows the silty clay layer encountered in the two borings below the fill materials and alum residue. The thickness of this clay layer as measured in Borings B-1 and B-2 was approximately 6 and 10 feet, respectively. As shown in the cross section, the sand materials encountered in the aquifer become somewhat coarser near the bedrock surface. Although no rock

coring was conducted, bedrock is believed to be limestone, based on inspection of rock chips found in the drilling returns. The two borings also indicate the bedrock surface is locally dipping slightly to the east.

Field notes compiled during drilling at the piezometer locations generally confirm the near-surface stratigraphic information obtained from the two deep soil borings. Details of piezometer installation and the generalized stratigraphy at each piezometer boring are shown in the figures included in Appendix B. Stratigraphy was determined by inspection of drill cuttings and the aquifer samples collected.

Ground Water Elevation

Table 1 presents elevations of the top of the PVC piezometer pipes and ground water elevations. The ground water elevations shown in Table 1 were used to construct the ground water contours shown in Figure 1 and to determine the direction of ground water flow. Figure 1 shows a ground water divide occurs beneath the site, with flow occurring in both a south-southwesterly direction and to the east-southeast, as explained below.

Ground water elevations across the site ranged from 403.97 feet mean sea level (MSL) in Piezometer PZ-1 to a high of 409.37 feet MSL in PZ-5. The water elevation in PZ-5 is significantly higher than the next highest ground water elevation found on site (406.61 feet MSL in PZ-4). Figure 1 shows ground water flow radiating from the area around PZ-5. Piezometer PZ-5 is located on an embankment between the storm water ditch and the pond water return ditch. The clay layer encountered elsewhere on the site at shallow depth is absent at this location. These conditions suggest ground water recharge from one or both of the ditches may be occurring in the vicinity of PZ-5.

It is expected that the ground water divide shown in Figure 1 is a localized effect caused by recharge from the ditch system. The regional ground water flow direction is expected to be to the southwest.

Ground Water Quality

The results of analysis of ground water samples obtained from the eight piezometers are summarized in Table 2. Water quality varied across the site, with the overall best ground water quality found in Piezometers PZ-2, PZ-6, and PZ-8.

The parameter concentrations found in PZ-5, along with the anomalous high ground water elevation, suggest this area is receiving recharge from the pond water return ditch. Most notable among these is the high water temperature (28 degrees Celsius) and low pH (3.97) encountered at this location.

Piezometer PZ-1 is located in the southwestern portion of the site. The dissolved iron and manganese levels at this location are higher than at other locations. Piezometers PZ-3, PZ-4, and PZ-7, which are located near the center of the site, show water quality which is intermediate to that found in Piezometers PZ-8, PZ-6, and PZ-1.

The source of the high dissolved iron and manganese levels found in PZ-1 is unknown. The lower portion of the aquifer beneath the site contains high levels of total iron, as evidenced by the visible iron staining surrounding the plant production well, the appearance of the water encountered in the two deep soil borings, and historical records of deep ground water quality. Very little of this iron occurs in the upper portion of the aquifer, at least in dissolved (ferrous) form, as evidenced by the low dissolved iron levels found in all wells except PZ-1. The elevated dissolved iron and manganese levels found in PZ-1 may be related to the sulfuric acid production facility which used to occupy this location.

Oil and grease were detected only in Piezometer PZ-5 and at a low concentration (1.3 mg/P). Some equipment difficulties were encountered during drilling at this location which resulted in drilling tools being left in the boring overnight. Another potential source of this contaminant is runoff and infiltration from the adjacent residential area.

PIEZOMETER SENSITIVITY TESTING

Table 3 presents aquifer permeabilities determined in the eight piezometers installed on site using the falling head method of measurement. By this method, the piezometer riser pipe is filled with water and periodic measurements of the falling water level inside the piezometer are made until stabilization occurs. The resulting data were plotted and used to calculate aquifer permeability.

Aquifer permeability at three locations (PZ-6, PZ-7, and PZ-8) is great enough that the piezometer riser pipes could not be filled with water, indicating the piezometers are in adequate communication with the aquifer and establishing minimum values for aquifer permeability at these locations at approximately 1.0×10^{-2} centimeter per second (cm/sec). Permeability values for the aquifer at Piezometers PZ-7 and PZ-8, as calculated from the grain-size distribution of formation samples collected during drilling, agree with this estimate (Table 3). Permeability values in Piezometers PZ-1 through PZ-5 ranged from 1.7×10^{-4} to 1.5×10^{-3} cm/sec. These values are within the range typical of the sand encountered in the upper portion of the aquifer, indicating the piezometers are functioning properly.

Six samples of the upper aquifer deposits sampled during piezometer installation were analyzed for grain-size distribution. Results are presented in graphic and tabular form in Appendix C. These analyses indicate the upper aquifer consists of fine to very fine sand with trace to some silt. Most samples contained relatively small amounts of silt and clay, although the range of this fraction varied from about 5 to 30 percent by weight. The majority of all samples analyzed passed the No. 60 sieve (0.250 mm), as evidenced by the steeply sloping line presented on the distribution graphs in Appendix C. Small (0.006 inch) screen slot size and a gravel pack were included in the piezometer design in anticipation of the fine-grained nature of the aquifer materials to minimize collection of silt in the wells. Additionally, the grain-size distribution information was used to compare published permeability values for similar materials with those obtained through the falling head tests. Values obtained in the field compared favorably with published values (Hough, "Basic Soils Engineering," 2nd Edition, 1969).

INFLUENCE OF THE PLANT PRODUCTION WELL

Measurements made of the water level in the plant production well during pumping and nonpumping periods varied by less than 0.5 foot (21.70 versus 21.25 feet below ground surface). Considerable difficulty was encountered in gaining access inside the plant production well. Once access was located, it was determined that no measurements could be made while the pump was operating, due to water from the pump returning to the well through the access plug. This water readily triggered the ground water level indicator (M-scope). To obtain a drawdown measurement approximately equal to that reached during extended pumping, the measurement was made immediately after the pump was turned off.

Table 4 summarizes data provided by Allied concerning periods of use of the plant production well for the years 1982 and 1983, with days of usage estimated for the last three months of 1983. Pump usage is sporadic, ranging from nearly every day use in March and April of 1982 to months with virtually no usage. Allied estimates its normal pumping rate over most of this period was approximately 60 gallons per minute (gpm). Measurements made by Allied, while D'Appolonia was on site, indicated a maximum discharge capability of approximately 150 gpm.

Table 5 further breaks down pumpage by hours of daily operation for the period of July 23 through September 14, 1983. Again, pumpage is sporadic, with pumping cycles ranging from none per day to continuous operation for several days at a time. Although details of weekend pumping periods cannot be readily discerned from Table 5, it does not appear that continuous pumpage has occurred over this period for more than 4, or possibly, 5 days.

The influence of the plant production well on ground water elevations, although not regionally significant, should be somewhat greater than that indicated by the pumping and nonpumping ground water levels measured by D'Appolonia. The pumping rates, periods of operation, and thickness and permeability of the aquifer indicate the drawdown of the water level in the well should be deeper than field measurements have indicated.

An attempt was made to quantify the results obtained through the field measurements with expected values as calculated by the Theis equation. Separate calculations were prepared for pumping periods of 1 day and 5 days, and are presented in Appendix D. A conservative aquifer permeability of 1.0×10^{-3} cm/sec, as determined by the falling head permeability tests conducted on site, was used in the calculations. The primary purpose of these calculations was to determine the amount of drawdown that could be expected in the production well and at various distances away from the well. A pumping rate of 150 gpm was used in the calculations and drawdown was calculated at radii of 1.5 (the well radius), 5, 50, and 200 feet.

As shown in the table in Appendix D, significant drawdown occurs within the well itself when pumping continues for one day or more. Drawdown decreases rapidly as distance from the well increases, with the drawdown for both cases at the 200-foot radius becoming practically insignificant. While these calculations indicate the measurements made in the production well are probably invalid, they also indicate the zone of influence of the well is relatively small and within the limits of the plant property.

It should be noted that the Theis equation is normally applied only to wells screened throughout the entire length of the aquifer and located in confined aquifers; neither condition exists in this case. These two assumptions will cause the drawdown values calculated at the 1.5- and 5.0-foot radii to be somewhat smaller than actual values. The difference in real and calculated values decreases significantly as distance from the well increases, such that the values obtained for the 50- and 200-foot radii are essentially correct.

CONCLUSIONS

Following are the major conclusions of the hydrogeologic assessment:

- Much of the site has been filled with a variable thickness of process residue. Stratigraphy below the fill generally consists of a 5- to 10-foot-thick clayey silt to silty clay layer overlying the aquifer. Aquifer materials consist primarily of fine- to medium-grained sand grading to

coarser materials at depth. These sandy deposits are approximately 100 feet thick and are underlain by limestone bedrock which was encountered approximately 120 to 125 feet below ground surface.

- A ground water flow divide occurs beneath the site, apparently induced by ground water recharge occurring in the vicinity of PZ-5, as shown in Figure 1. The average permeability of the aquifer measured near the top of the saturated zone is 6.2×10^{-4} cm/sec. Local aquifer permeability is somewhat higher near Piezometers PZ-6, PZ-7, and PZ-8, where sensitivity tests could not be conducted. Ground water beneath the site has an effective pore velocity of 2.6×10^{-6} foot per second (ft/sec) and migrates approximately 82 feet annually. More than 28 million gallons of ground water passes beneath the site annually.

- The plant production well exerts a minor influence on ground water movement across the site. The calculated radius of this zone of influence is less than 200 feet.

- Little or no potential exists for ground water contamination originating off site to migrate toward the plant property. The nearest potential industrial sources are downgradient from the site and no known potential contaminant sources exist upgradient from the site. However, an area of dark gray to black soil-like materials exists on a corner of an adjacent property, north of the plant offices and west of the old alum residue area. Although the nature of these materials is unknown, they potentially influence downgradient water quality at PZ-1.

- Due to the ground water flow divide encountered on site, the locations of Piezometers PZ-8 and PZ-7 may not be upgradient and downgradient, respectively, of the active alum residue pond, as had been intended. The relatively good water quality at PZ-8, however, suggests the effect of recharge from the ditch system is limited at this location and that the water quality at PZ-8 is representative of background conditions. It is expected that in the absence of the ground water

mound, PZ-8 and PZ-7 would be more representative of upgradient and downgradient locations relative to the pond, as defined by the historic regional ground water flow direction (southwest).

- The piezometer installed in the northwestern corner of the site (PZ-5) is apparently located in a ground water recharge area. No near-surface clay layer was encountered during drilling of this boring. The measured ground water elevation is anomalously high and ground water quality suggests contamination by infiltration of pond return water. Suspected infiltration sources are the adjacent storm water collection ditch and, specifically, the pond return ditch, although off-site influences cannot be ruled out.

D'Appolonia appreciates this opportunity to have been of service to Allied, and we hope we may assist you on other projects in the future. Please contact either of us with your questions and comments regarding this report and to arrange for the project review meeting.

Respectfully submitted,

Larry R. Sweeney

Larry R. Sweeney
Assistant Project Scientist

Jeffrey L. Hosler
Project Supervisor

LRS:JLH:rjt
Enclosures

TABLES

TABLE 1

PIEZOMETER AND GROUND WATER ELEVATIONS[1]

PIEZOMETER	RISER PIPE ELEVATION[2] (ft)	DEPTH TO GROUND WATER[3] (ft)	GROUND WATER ELEVATION (ft)
PZ-1	425.91	21.94	403.97
PZ-2	427.18	21.45	405.73
PZ-3	439.35	34.45	404.90
PZ-4	449.11	42.50	406.61
PZ-5	424.17	14.80	409.37
PZ-6	419.33	13.85	405.48
PZ-7	442.35	36.65	405.70
PZ-8	423.75	18.80	404.95

(1) Surveying conducted by Lopinot and Weber, Inc., St. Louis, Missouri. Reference datum obtained from Illinois Department of Transportation (railyard overpass on Kingshighway near plant entrance.

(2) Measured at top of riser pipe.

(3) Depth below top of riser pipe. Measured prior to development and sampling during the week of September 12 through 16, 1983.

TABLE 2

GROUND WATER QUALITY DATA

WELL NO.	FIELD MEASUREMENTS			LAB ANALYSES				
	pH (S.U.)	TEMPERATURE (°C)	SPECIFIC CONDUCTANCE (µmhos)	FILTERABLE RESIDUE[1] (mg/ℓ)	SULFATE (mg/ℓ)	DISSOLVED IRON (mg/ℓ)	DISSOLVED MANGANESE (mg/ℓ)	OIL AND GREASE (mg/ℓ)
PZ-1	5.90	14	2,600	3,996	2,200	105.0	58.0	<0.5
PZ-2	7.65	16	620	633	225	0.4	0.4	<0.5
PZ-3	5.25	15	1,900	2,358	1,450	13.0	9.9	<0.5
PZ-4	5.55	16	2,320	3,502	1,700	4.7	5.8	<0.5
PZ-5	3.97	28	4,250	4,524	2,700	1.5	3.7	1.3
PZ-6	7.08	16	1,030	1,497	690	1.6	1.8	<0.5
PZ-7	6.45	17	2,300	2,342	1,350	0.3	5.0	<0.5
PZ-8	7.55	18	520	417	150	1.5	<0.1	<0.5

[1] Total Dissolved Solids.

TABLE 3

RESULTS OF AQUIFER PERMEABILITY MEASUREMENTS

PIEZOMETER NO.	K (cm/sec)[1]	K (cm/sec)[2]
PZ-1	1.7×10^{-4}	Not measurable[3]
PZ-2	1.5×10^{-3}	Not measurable[4]
PZ-3	3.4×10^{-4}	Not measurable[4]
PZ-4	2.4×10^{-4}	Not measurable[4]
PZ-5	8.4×10^{-4}	Not measurable[4]
PZ-6	Not measurable[5]	Not measurable[3]
PZ-7	Not measurable[5]	1.0×10^{-2}
PZ-8	Not measurable[5]	1.0×10^{-2}

[1] Utilized falling head testing methodology.

[2] Calculated from formation sample grain-size distribution after Hazen (Freeze, R. A. and J. A. Cherry, 1979, Groundwater, Prentice-Hall, Inc., 604 pp.).

[3] Grain-size distribution not analyzed.

[4] Not calculable from grain-size distribution due to percentage of fine-grained material (fraction passing No. 200 sieve).

[5] Piezometer standpipe could not be filled with water due to excessive permeability.

TABLE 4

PLANT PRODUCTION WELL USAGE

MONTHLY TIME PERIOD	NO. OF DAYS USED	MONTHLY TIME PERIOD	NO. OF DAYS USED
01/82	6	01/83	-
02/82	10	02/83	-
03/82	30	03/83	5
04/82	30	04/83	-
05/82	1	05/83	-
06/82	-	06/83	3
07/82	5	07/83	9
08/82	9	08/83	25
09/82	8	09/83	15
10/82	-	10/83	15 (estimated)
11/82	4	11/83	15 (estimated)
12/82	7	12/83	15 (estimated)
Total Days Used:	110	Total Days Used:	102
Total Water Pumped:(1) 9,500 m gal		Total Water Pumped:(1) 8,800 m gal	

(1) The average estimated flow for normal pumping is 60 gpm. Total water pumped calculated by the formula below:

60 gpm x no. days used x 1,440 min/day

TABLE 5

DETAILED PRODUCTION WELL USAGE
07/23/83 THROUGH 09/14/83

DATE	HOURS OF OPERATION	ALUM PLANT OPERATION
07/23	22.5	
07/24	23.4	
07/25	21.2	
07/26	24.0	
07/27 to 07/31	78.4	
08/01	16.0	08/04 to 08/05 - Down
08/02	23.3	
08/03 to 08/07	70.4	
08/08	14.6	
08/09	19.8	
08/10	18.4	
08/11	24.0	
08/12 to 08/14	71.6	
08/15	24.0	
08/16	24.0	
08/17	24.0	
08/18	6.4	
08/19 to 08/21	64.8	
08/22	24.0	
08/23	22.0	
08/24	24.0	
08/25	24.0	
08/26 to 08/28	28.2	08/27 to 08/28 - Down
08/29	4.4	Down
08/30 to 09/05	93.6	08/30 to 09/05 - Down
09/06	21.2	Down
09/07	9.9	Down
09/08	-	Down

TABLE 5
(Continued)

DATE	HOURS OF OPERATION	ALUM PLANT OPERATION
09/09 to 09/11	18.5	09/09 to 09/10 - Down
09/12	24.0	
09/13	24.0	
09/14	24.0	
Total Daily Hours of Operation: (07/23/83 to 09/14/83)	912.6	
Average Daily Hours Over 54-Day Period:	16.9	
		Alum plant down a total of 17 days during period

FIGURES

SDMS US EPA REGION V

COLOR-RESOLUTION - 2

IMAGERY INSERT FORM

The following page(s) of this document include color or resolution variations. Unless otherwise noted, these pages are available in monochrome. The original document is available for viewing at the Superfund Records Center.

SITE NAME	MOBIL OIL TERM
DOC ID #	154467
DESCRIPTION OF ITEM(S)	SITE MAP
PRP	PAS - MOBIL OIL TERM
DOCUMENT VARIATION	___ COLOR **OR** _X_ RESOLUTION
DATE OF ITEM(S)	9/30/83
NO. OF ITEMS	1
PHASE	SID
OPERABLE UNITS	
PHASE (AR DOCUMENTS ONLY)	___ Remedial ___ Removal ___ Deletion Docket ___Original ___ Update # ___ Volume ___ of ___
COMMENT(S)	
PIEZOMETER LOCATIONS & GROUND WATER CONTOURS FIGURE 1	

FIGURE 1

PIEZOMETER LOCATIONS AND GROUND WATER CONTOURS

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

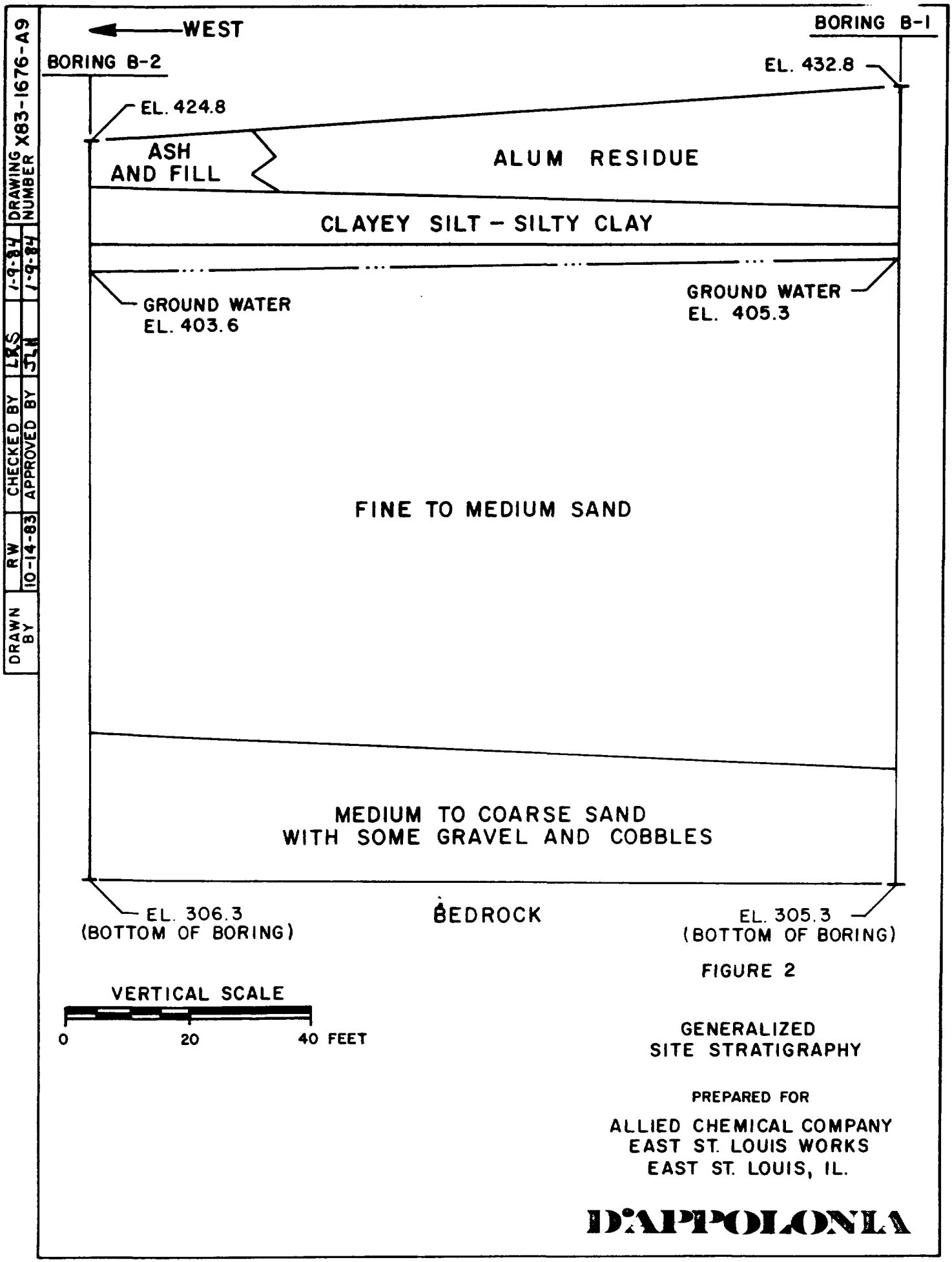

FIGURE 2

GENERALIZED SITE STRATIGRAPHY

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

APPENDIX A

BORING LOGS

DAPPOLONIA

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: X83-1676-DW	PROJECT NAME: ALLIED CHEMICAL		
BORING NUMBER: B-1	COORDINATES: NA	DATE: 9/7/83	
ELEVATION: 432.80	GWL: Depth 27.5' Date/Time 9-7/1000	DATE STARTED: 9/7/83	
ENGINEER/GEOLOGIST: LRS	Depth Date/Time	DATE COMPLETED: 9/8/83	
DRILLING METHODS: 3 1/4" - ID HSA to 31 FT; MUD ROTARY to BEDROCK		PAGE 1 OF 9	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0				SOFT BLACK AND WHITE SILT - MOIST 0.5'	MH	—	
	S-1	1 1 2	12	VERY LOOSE LIGHT BROWN FINE SAND WITH SOME SILT - MOIST ~2.0'	SP	—	
1.5							
2.5	S-2	2 1 1	10	VERY SOFT PINKISH GRAY SILT WITH TRACE CLAY AND TRACE FINE SAND - MOIST ~4.5'	MH	—	
4.0							
5.0	S-3	1/12" 1	18	VERY LOOSE LIGHT GRAY FINE SAND WITH SOME SILT - MOIST	SP	—	
6.5							
7.5	S-4	WH/18"	18	VERY LOOSE LIGHT GRAY FINE SAND WITH SOME SILT - MOIST ~9.5'	SP	—	
9.0							
10.0	S-5	WH 1 2	18	VERY SOFT LIGHT BROWNISH GRAY TO WHITE SILT WITH SOME INTERBEDDED SAND - MOIST ~12.0'	MH	—	
11.5							
12.5	S-6	WH/18"	18	VERY SOFT LIGHT BROWNISH GRAY SILT - WET	MH	—	
14.0							
15.0							

NOTES:

WH = WEIGHT OF HAMMER (NO BLOWS REQUIRED)

DAPTPOLONIA

VISUAL CLASSIFICATION OF SOILS

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ENGINEER/GEOLOGIST: LRS	Depth Date/Time	DATE COMPLETED: 9/8/83
DRILLING METHODS: 3¼"-ID HSA to 31 FT. & MUD ROTARY to BEDROCK		PAGE 2 OF 9

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 inches	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
15.0							
	S-7	WH/18"	18	VERY SOFT LIGHT GRAY SILT - MOIST TO WET	MH	—	
16.5				~17.0'			
17.5	S-8	WH/18"	18	VERY SOFT LIGHT GRAY CLAYEY SILT - MOIST TO WET	MH	—	
19.0				~19.5'			
20.0	S-9	2 3 5	14.5	STIFF DARK GRAY CLAY WITH SOME SILT - MOIST	CL	—	
21.5				~22.0'			
22.5	S-10	1 3 4	17	STIFF DARK GRAY TO BROWN SILTY CLAY - MOIST	CL	—	
24.0							
25.0	S-11	5 6 7	18	~25.5'	CL	—	
				MEDIUM DENSE BROWN MEDIUM SAND - MOIST	SP	—	
26.5							
27.5	S-12	2 3 7	14	MEDIUM DENSE BROWN MEDIUM SAND - MOIST	SP	—	GROUNDWATER @ 27.5 FT. 9/7/83 - 1000 HRS.
29.0				~29.5'			
30.0							

NOTES:

DAPTOLONIA

VISUAL CLASSIFICATION OF SOILS

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DRILLING METHODS: 3¼"-ID HSA to 31 FT. ; MUD ROTARY TO BEDROCK		PAGE 3 OF 9

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
30.0	S-13	1 1 4	18	LOOSE BROWN FINE TO MEDIUM SAND - WET	SP	—	BEGAN MUD ROTARY AT 31 FT.
31.5				~32.5'			
32.5				MEDIUM DENSE BROWN FINE SAND - MOIST			
33.5	S-14	8 7 9	10		SP	—	
35.0				~35.5'			
36.0	S-15	6 11 14	10	MEDIUM DENSE BROWN WELL-SORTED SANDS WITH TRACE GRAVEL — MOIST	SW	—	
37.5							
38.5	S-16	6 7 16	11.5	MEDIUM DENSE BROWN WELL-SORTED SANDS WITH TRACE GRAVEL - MOIST	SW	—	
40.0				~40.5'			
41.0	S-17	11 13 13	14	MEDIUM DENSE BROWN FINE TO MEDIUM SAND - MOIST	SP	—	
42.5				~43.0'			
43.5	S-18	5 7 7	11	MEDIUM DENSE BROWN WELL-SORTED SANDS WITH TRACE GRAVEL — MOIST	SW	—	
45.0							

NOTES:

DAPPOLONIA

VISUAL CLASSIFICATION OF SOILS

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DRILLING METHODS: 3¼"-ID HSA to 31 FT.; MUD ROTARY to BEDROCK		PAGE 4 OF 9

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in.)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
45.0				~45.5'			
46.0	S-19	13 13 13	11	MEDIUM DENSE GRAYISH-BROWN FINE TO MEDIUM SAND WITH TRACE COARSE SAND AND GRAVEL - MOIST	SP	-	
47.5							
48.5	S-20	13 14 21	14	DENSE GRAYISH-BROWN FINE TO MEDIUM SAND WITH TRACE COARSE SAND AND GRAVEL - MOIST	SP	-	
50.0				~50.5'			
51.0	S-21	9 12 19	10	DENSE DARK GRAY FINE SAND - MOIST GRADING TO	SP	-	
52.5							
53.5	S-22	11 14 18	10	DENSE DARK GRAY FINE TO MEDIUM SAND - MOIST	SP	-	
55.0							
56.0	S-23	16 42 33	12.5	VERY DENSE DARK GRAY FINE TO MEDIUM SAND - MOIST	SP	-	
				57.0'			
57.5				VERY DENSE DARK GRAY VERY FINE TO FINE SAND - MOIST GRADING TO	SP	-	
58.5	S-24	12 22 24	13.5	DENSE DARK GRAY FINE TO MEDIUM SAND - MOIST	SP	-	
60.0							

NOTES:

DAMPOLONIA

VISUAL CLASSIFICATION OF SOILS

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DRILLING METHODS: 3¼"-ID HSA to 31 FT.; MUD ROTARY to BEDROCK		PAGE 5 OF 9

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
60.0				GRADING TO			BEGIN 5-FT. SAMPLING INTERVAL (CLIENT'S REQUEST)
62.5							
63.5	S-25	15 21 33	15	VERY DENSE DARK GRAY VERY FINE TO FINE SAND - MOIST	SP	-	
65.0				GRADING TO			
67.5							
68.5	S-26	10 11 10	9	MEDIUM DENSE DARK GRAY FINE TO MEDIUM SAND - MOIST	SP	-	
70.0							
72.5							
73.5	S-27	8 11 9	8	MEDIUM DENSE DARK GRAY MEDIUM TO COARSE SAND - MOIST	SP	-	
75.0							

NOTES:

DAPTOLONIA

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DRILLING METHODS: 3¼" - ID HSA to 31 FT.; MUD ROTARY to BEDROCK		PAGE 6 OF 9

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
75.0							BEGIN 10-FT. SAMPLING INTERVAL
77.5							DRILLER NOTED SOMEWHAT COARSER ZONE FROM ~76' to ~78'
80.0							
82.5							
83.5	S-28	12 18 18	10	DENSE DARK GRAY MEDIUM TO COARSE SAND - MOIST	SP	—	
85.0							
87.5							
90.0							

NOTES:

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ENGINEER/GEOLOGIST: LRS	Depth Date/Time	DATE COMPLETED: 9/8/83
DRILLING METHODS: 3¼"-ID HSA to 31 FT.; MUD ROTARY to BEDROCK		PAGE 7 OF 9

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
90.0							
92.5							
93.5	S-29	3 5 12	11	MEDIUM DENSE DARK GRAY TO MEDIUM SAND WITH SOME VERY FINE SAND, TRACE COARSE SAND AND TRACE GRAVEL; INTERBEDDED ORGANICS (WOOD) — MOIST	SW	—	
95.0							
~97.5							
97.5							
100.0							
102.5							
103.5	S-30	17 15 13	11	MEDIUM DENSE DARK GRAY FINE TO MEDIUM SAND — MOIST	SP	—	
105.0							

NOTES:

D'APPOLONIA

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DRILLING METHODS: 3¼"-ID HSA to 31 FT.; MUD ROTARY to BEDROCK		PAGE 8 OF 9	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
105.0							
107.5							
110.0				~110.0'			
112.5							
113.5	S-31	25 48 26	13.5	VERY DENSE DARK GRAY MEDIUM SAND WITH SOME INTERBEDDED FINE AND COARSE SAND AND TRACE GRAVEL - MOIST	SW	—	
115.0							
117.5							
120.0							

NOTES:

DAPPOLONIA

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DRILLING METHODS: 3¼"-ID HSA to 31 FT.; MUD ROTARY to BEDROCK		PAGE 9 OF 9

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
120.0							
122.5							AT 123.5', ENCOUNTERED INCREASED RESISTANCE TO DRILLING; ADDED ANOTHER ROD TO CHECK FOR ROCK AND THUS DID NOT SAMPLE FROM 123.5' to 125.0' COARSE SANDS IN RETURNS AND LOSS OF FLUID
123.5							
125.0							
127.5				127.5 FT. BOTTOM OF BORING			GRAY-WHITE CHIPS IN RETURNS (LIMESTONE?) REFUSAL AT 127.5 FT.

NOTES:

DAMPOLONIA

VISUAL CLASSIFICATION OF SOILS

PROJECT NUMBER: X83-1676-DW	PROJECT NAME: ALLIED CHEMICAL	
BORING NUMBER: B-2	COORDINATES: NA	DATE: 9/8/83
ELEVATION: 424.80	GWL: Depth 21.2' Date/Time 9-8/1600	DATE STARTED: 9/8/83
ENGINEER/GEOLOGIST: LRS	Depth 19.6' Date/Time 9-9/0815	DATE COMPLETED: 9/9/83
DRILLING METHODS: 3¼" ID HSA to 24 FT.; MUD ROTARY TO BEDROCK		PAGE 1 OF 8

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
0	S-1	7 7 7	18	VERY SOFT LT. BROWN CLAYEY SILT - DRY 0.5'	ML	—	
				VERY SOFT GRAY-WHITE SILT - DRY 1.0'	ML	—	
1.5				SOFT ORANGE-BROWN CLAYEY SILT - DRY	ML	—	
2.5	S-2	3 3 2	14	SOFT ORANGE-BROWN CLAYEY SILT - DRY 3.0'	ML	—	SLIGHT SULFUR SMELL
				SOFT ORANGE, BLACK AND YELLOW SILTY SAND - DRY	SW	—	ASHES
4.0				~4.5'			
5.0	S-3	2 2 1	12	SOFT BLACK AND YELLOW SAND - MOIST	SW	—	ASHES CONTAINS SOME COAL-LIKE MATERIAL
6.5				~7.0'			
7.5	S-4	1 2 6	14	MEDIUM STIFF GRAY TO BLACK CLAY WITH SOME SILT AND TRACE INTERBEDDED SAND - MOIST	CL	—	
9.0				~9.5'			
10.0	S-5	2 5 9	15	STIFF DARK GRAY CLAY WITH SOME SILT - MOIST	CL	—	
11.5				~12.0'			
12.5	S-6	3 3 4	16	STIFF TO MEDIUM STIFF LIGHT GRAY SILT WITH SOME CLAY - MOIST	MH	—	
14.0							
16.0							

NOTES:

DAPTOLONIA

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DRILLING METHODS: 3¼"-ID HSA to 24 FT.; MUD ROTARY TO BEDROCK		PAGE 2 OF 8	

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
16.0	S-7	2 2 6	15	MEDIUM STIFF LIGHT GRAY SILT WITH SOME CLAY - MOIST	MH	—	
16.3							
16.5				LOOSE ORANGE FINE SAND - MOIST	SP	—	
17.5	S-8	6 11 12	10	MEDIUM DENSE LIGHT BROWN FINE SAND - DAMP	SP	—	
19.0				~19.5'			
20.0	S-9	6 9 11	13	MEDIUM DENSE GRAYISH BROWN VERY FINE SAND - WET	SP	—	GROUNDWATER @ 21.2' 9/8/83 - 1600 HRS
21.5							
22.5	S-10	5 13 18	18	DENSE GRAYISH BROWN VERY FINE SAND - WET	SP	—	
24.0				~24.5'			BEGAN MUD ROTARY DRILLING AT 24'
25.0	S-11	10 15 25	12	DENSE GRAY FINE TO MEDIUM SAND - MOIST	SP	—	
26.5				~27.0'			
27.5	S-12	2 2 4	14	VERY SOFT DARK GRAY CLAY - MOIST 28.0'	CL	—	
29.0				LOOSE DARK GRAY SILTY VERY FINE SAND - MOIST ~29.5'	SM	—	
30.0							

NOTES

DAPPOLONIA

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DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
30.0							
	S-13	5 4 7	12	MEDIUM DENSE GRAY FINE TO VERY FINE SAND WITH TRACE TO SOME INTERBEDDED CLAY - WET	SP/CL	—	
31.5				~32.0'			
32.5							
	S-14	10 16 29	11	DENSE GRAY FINE SAND - MOIST TO WET	SP	—	
34.0				~34.5'			
35.0							
	S-15	8 10 12	10	MEDIUM DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	—	
36.5							
37.5							
	S-16	7 13 19	11	DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	—	
39.0							
40.0							
	S-17	16 15 8	11	MEDIUM DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	—	
41.5							
42.5							
	S-18	10 10 11	13	MEDIUM DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	—	
44.0							
46.0							

NOTES:

DAPTOLONIA

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DRILLING METHODS: 3¼"-ID HSA to 24 FT.; MUD ROTARY to BEDROCK		PAGE 4 OF 8

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
45.0	S-19	15 14 16	16	MEDIUM DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	–	
46.5							
47.5	S-20	11 12 19	13	DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	–	
49.0							
50.0	S-21	8 10 16	13	MEDIUM DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	–	
51.5				~52.0'			
52.5	S-22	14 18 20	10	DENSE GRAY FINE TO MEDIUM SAND WITH TRACE GRAVEL - MOIST TO WET	SP	–	
54.0				~54.5'			
55.0	S-23	19 18 15	14	DENSE GRAY FINE TO MEDIUM SAND WITH TRACE COARSE SAND AND TRACE GRAVEL - MOIST TO WET	SP	–	
56.5				~57.0'			
57.5	S-24	11 23 18	12	DENSE GRAY FINE TO MEDIUM SAND WITH SOME COARSE SAND - MOIST TO WET	SW	–	
59.0				~59.5'			
60.0							

NOTES:

DAPPOLONIA

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DRILLING METHODS: 3 1/4"-ID HSA to 24 FT.; MUD ROTARY to BEDROCK		PAGE 5 OF 8

DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
60.0	S-25	10 8 13	12.5	MEDIUM DENSE DARK GRAY AND BLACK FINE TO MEDIUM SAND - MOIST TO WET	SP	—	WILL BEGIN 10 FT. SAMPLING INTERVAL AFTER 60 FT.
61.5							
62.5							
65.0							
67.5							DRILLER NOTED ENCOUNTERING COARSER MATERIALS FROM 66 FT. to 68 FT.
70.0	S-26	34 30 17	16	DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	—	
71.5							
72.5							
75.0							

NOTES:

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DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
75.0							
77.5							
80.0	S-27	38 59 61	14	VERY DENSE GRAY FINE TO MEDIUM SAND - MOIST TO WET	SP	—	
81.5							
82.5							
85.0							
87.5							
90.0							

NOTES:

D'APPOLONIA

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DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER (6 inches)	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
90.0	S-28	14 27 34	13	VERY DENSE GRAY FINE TO MEDIUM SAND - MOIST	SP	—	
91.5							
92.5							
95.0				~95.0'			
97.5							
100.0	S-29	17 21 31	10	VERY DENSE GRAY MEDIUM TO COARSE SAND WITH TRACE TO SOME GRAVEL - MOIST	SP	—	
101.5							
102.5							
105.0				~105.0'			

NOTES:

D'APPOLONIA

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PROJECT NUMBER: X83-1676-DW	PROJECT NAME: ALLIED CHEMICAL	
BORING NUMBER: B-2	COORDINATES: NA	DATE: 9/9/83
ELEVATION: 424.80	GWL: Depth 21.2' Date/Time 9-8/1600	DATE STARTED: 9/8/83
ENGINEER/GEOLOGIST: LRS	Depth 19.6' Date/Time 9-9/0815	DATE COMPLETED: 9/9/83
DRILLING METHODS: 3¼"-ID HSA to 24 FT.; MUD ROTARY to BEDROCK		PAGE 8 OF 8

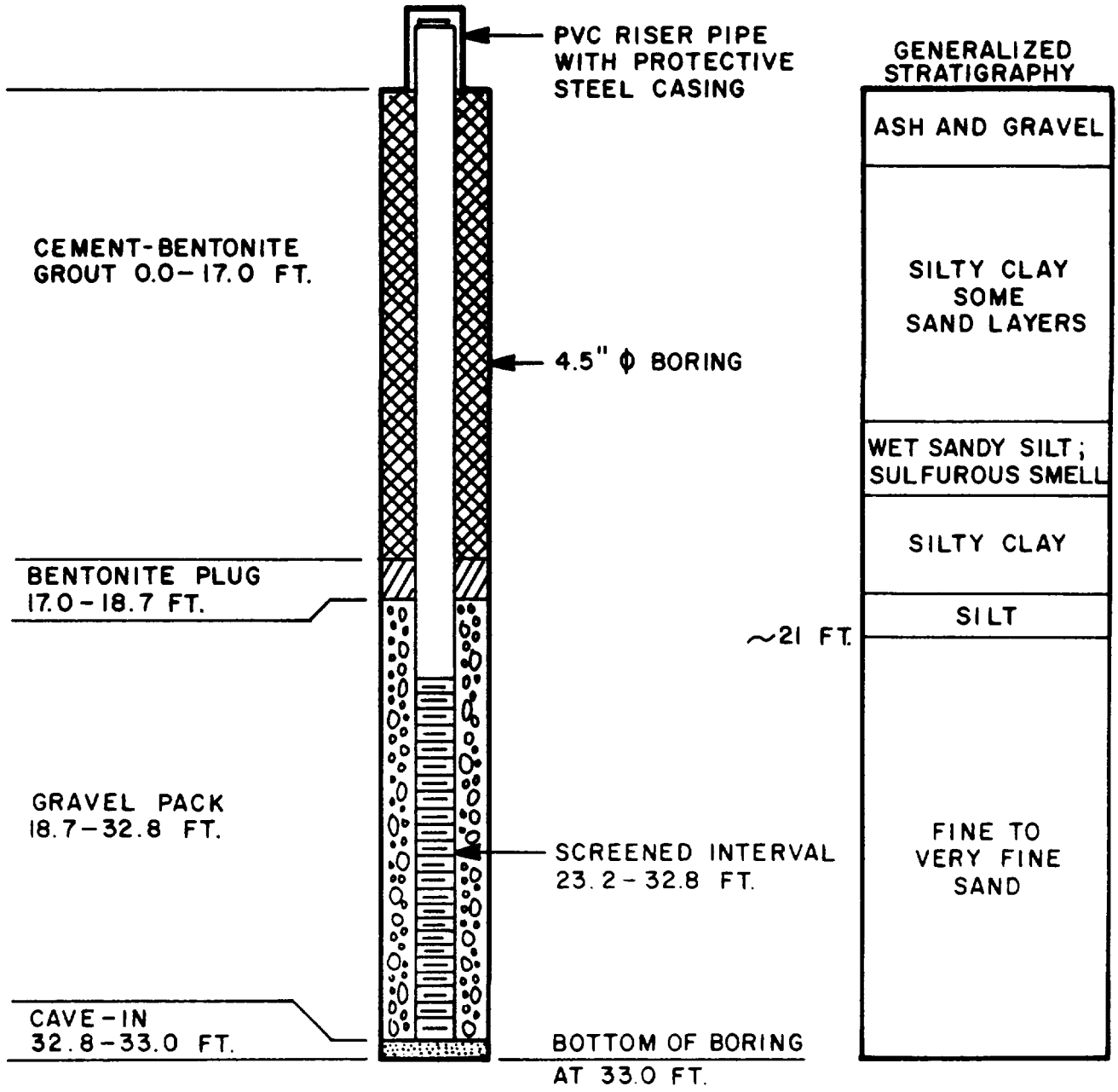
DEPTH (FT)	SAMPLE TYPE & NO.	BLOWS ON SAMPLER PER 6 inches	RECOVERY (in)	DESCRIPTION	USCS SYMBOL	MEASURED CONSISTENCY (TSF)	REMARKS
105.0							
107.5							
110.0	S-30	30 24 21	9	DENSE BROWNISH GRAY MEDIUM TO COARSE SAND WITH SOME GRAVEL AND TRACE COBBLE – MOIST	SP	–	SAMPLED THROUGH A COBBLE (GRANITE ?) AT 110 FT.
111.5							
112.5							
115.0							
117.5							
118.5				118.5' BOTTOM OF BORING			EQUIPMENT REFUSAL LIMESTONE CHIPS IN RETURNS

NOTES:

APPENDIX B

PIEZOMETER INSTALLATION DETAILS

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
RW 10-13-83	LRS 1-9-84	SLH 1-9-84	X83-1676-A1



NOTES:

1. RISER PIPE IS 2 IN. I.D. SCHEDULE 40 PVC PIPE.
2. SCREEN IS 2 IN. ID PVC PIPE CONTINUOUS SLOT SCREEN (0.006 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS SEALED WITH A THREADED PIPE CAP.
4. ELEVATION OF TOP OF RISER 425.91 FT.
5. ELEVATION OF WATER LEVEL 403.97 FT.
6. WATER LEVEL READING ON 9-13-83.

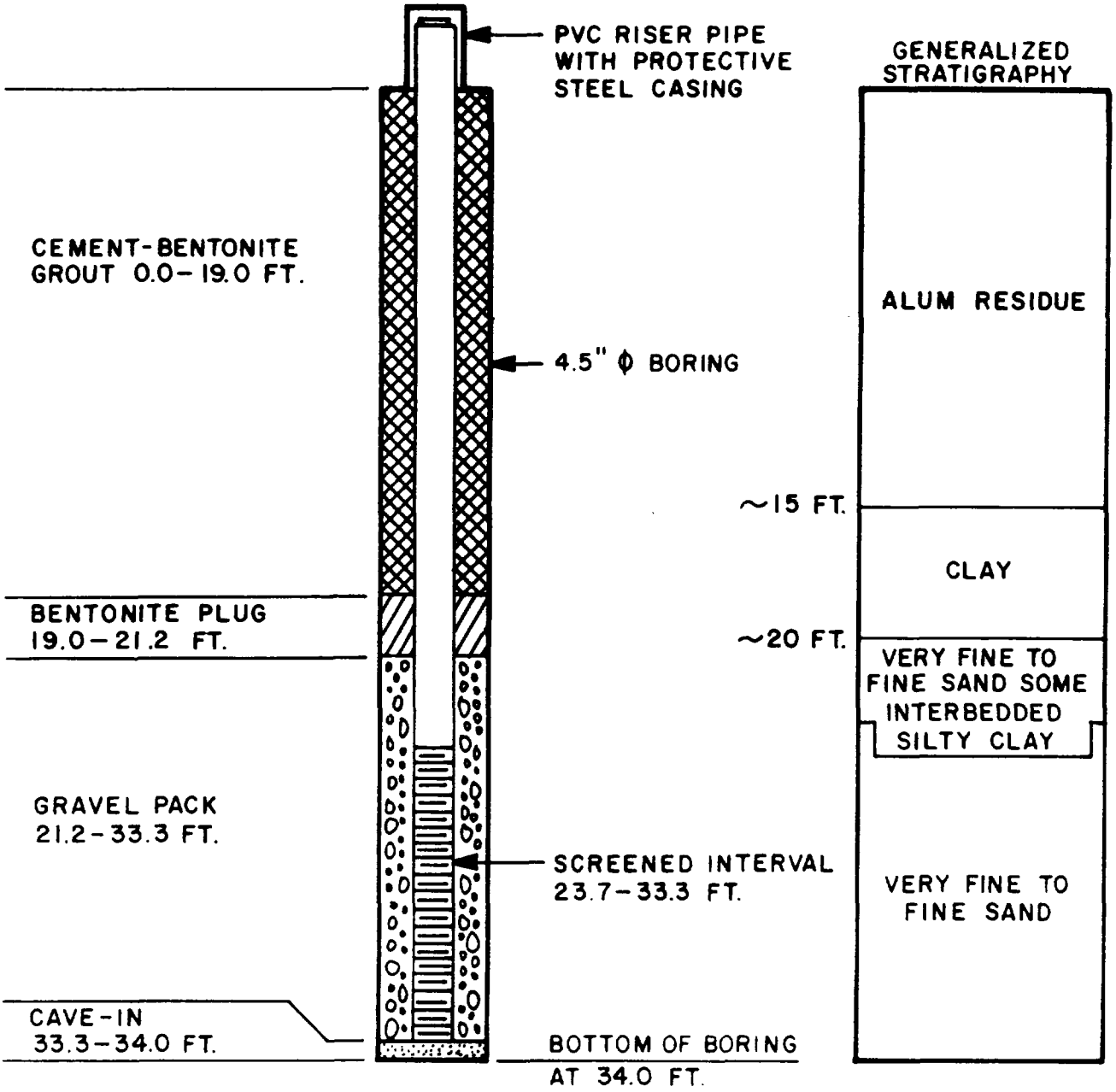
INSTALLATION DETAILS
PIEZOMETER PZ-1

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
RW 10-13-83	LRS 1-4-84	JLH 1-9-84	X83-1676-A 2



NOTES:

1. RISER PIPE IS 2 IN. I.D. SCHEDULE 40 PVC PIPE.
2. SCREEN IS 2 IN. ID PVC PIPE CONTINUOUS SLOT SCREEN (0.006 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS SEALED WITH A THREADED PIPE CAP.
4. ELEVATION OF TOP OF RISER 427.18 FT.
5. ELEVATION OF WATER LEVEL 405.73 FT.
6. WATER LEVEL READING ON 9-14-83.

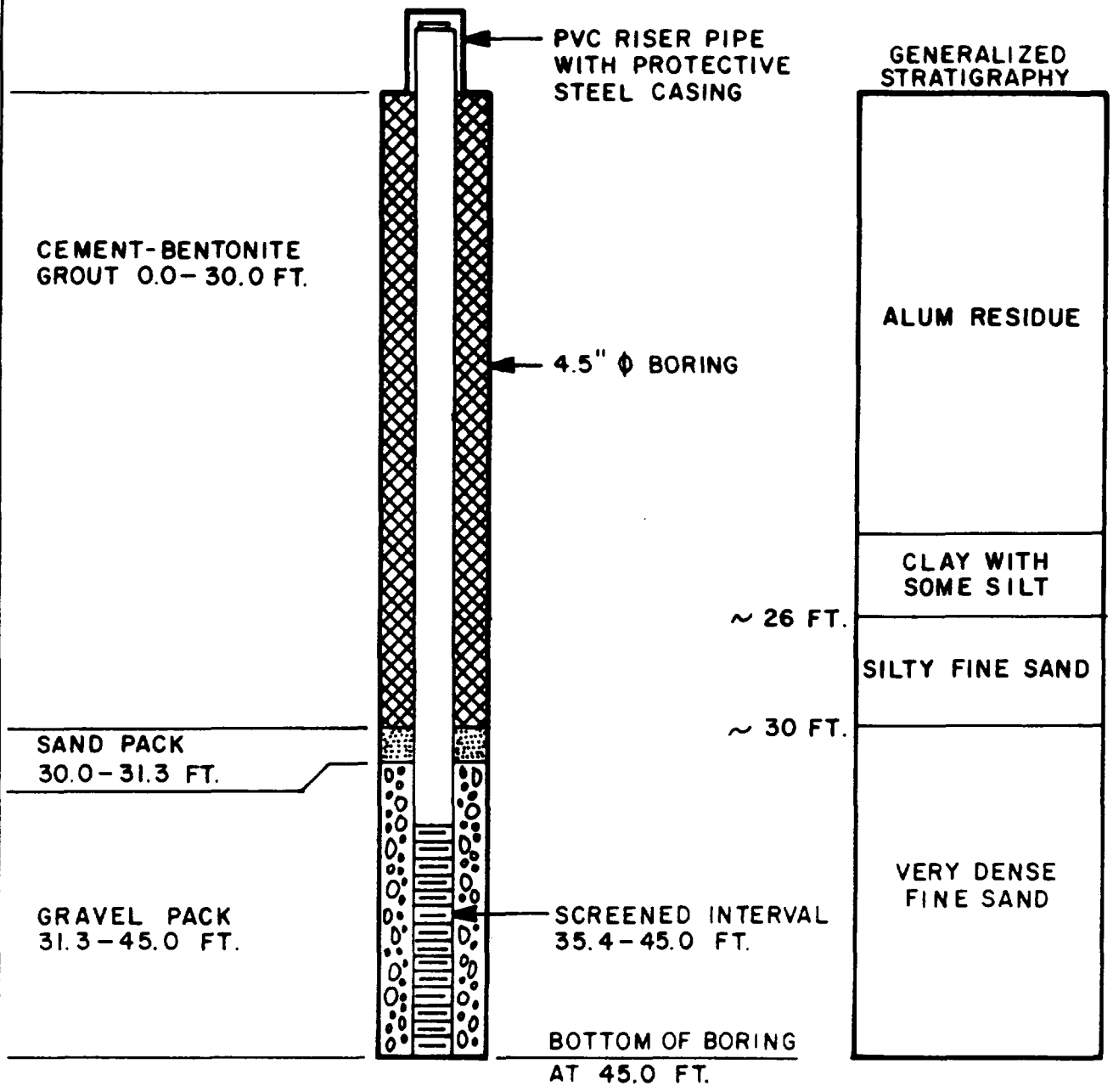
INSTALLATION DETAILS
PIEZOMETER PZ-2

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

DRAWN BY	RW	10-13-83
CHECKED BY	LRS	1-9-84
APPROVED BY	SLH	1-9-84
DRAWING NUMBER	X83-1676-A3	



NOTES:

1. RISER PIPE IS 2 IN. I.D. SCHEDULE 40 PVC PIPE.
2. SCREEN IS 2 IN. ID PVC PIPE CONTINUOUS SLOT SCREEN (0.006 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS SEALED WITH A THREADED PIPE CAP.
4. ELEVATION OF TOP OF RISER 439.35 FT.
5. ELEVATION OF WATER LEVEL 404.90.
6. WATER LEVEL READING ON 9-14-83.

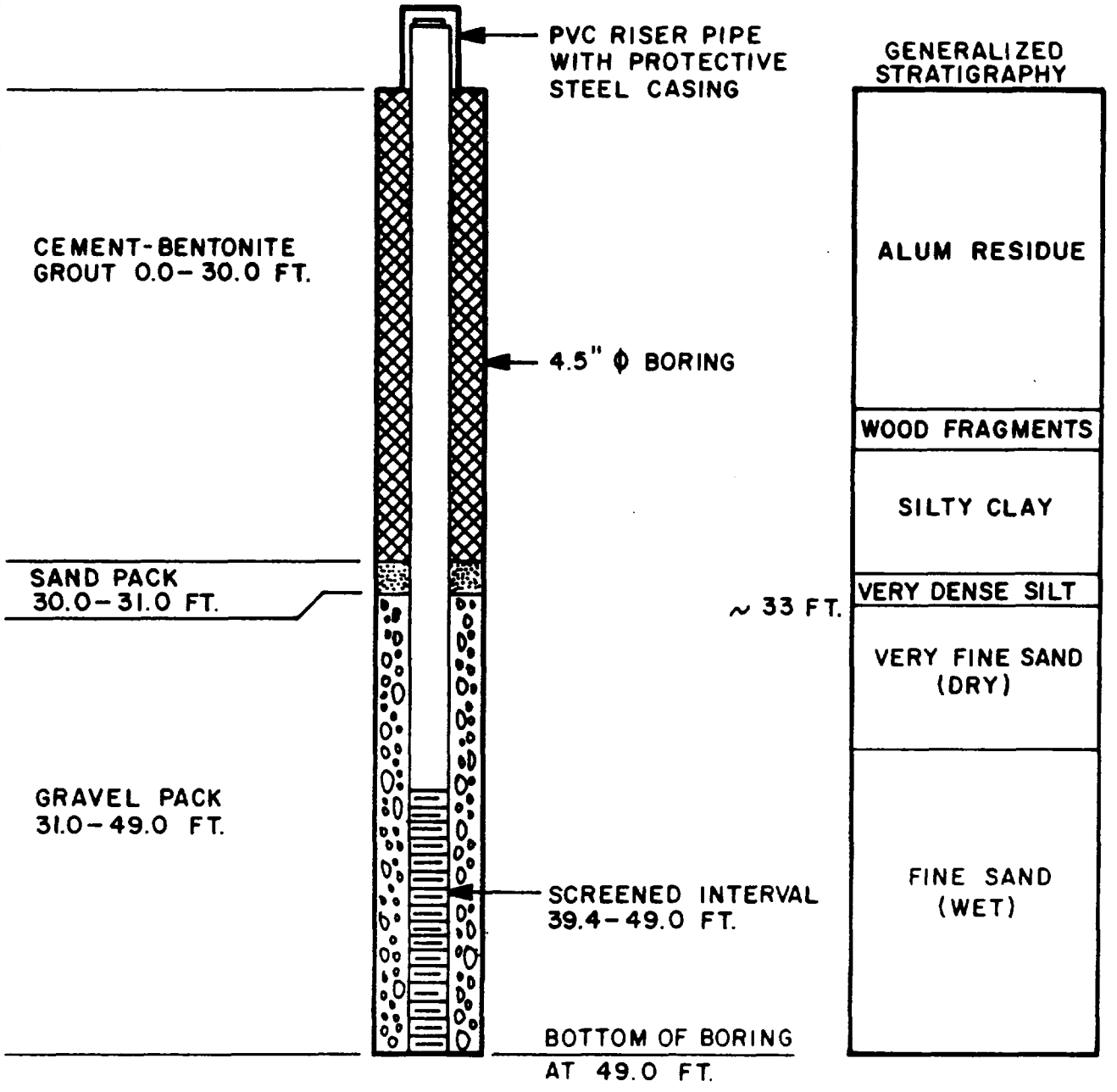
INSTALLATION DETAILS
PIEZOMETER PZ-3

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

DRAWN BY	CHECKED BY	DRAWING NUMBER
RW 10-13-83	APPROVED BY LRS 1-9-84 / SLH 1-9-84	X83-1676-A 4



NOTES:

1. RISER PIPE IS 2 IN. I.D. SCHEDULE 40 PVC PIPE.
2. SCREEN IS 2 IN. ID PVC PIPE CONTINUOUS SLOT SCREEN (0.006 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS SEALED WITH A THREADED PIPE CAP.
4. ELEVATION OF TOP OF RISER 449.11 FT.
5. ELEVATION OF WATER LEVEL 406.61 FT.
6. WATER LEVEL READING ON 9-14-83.

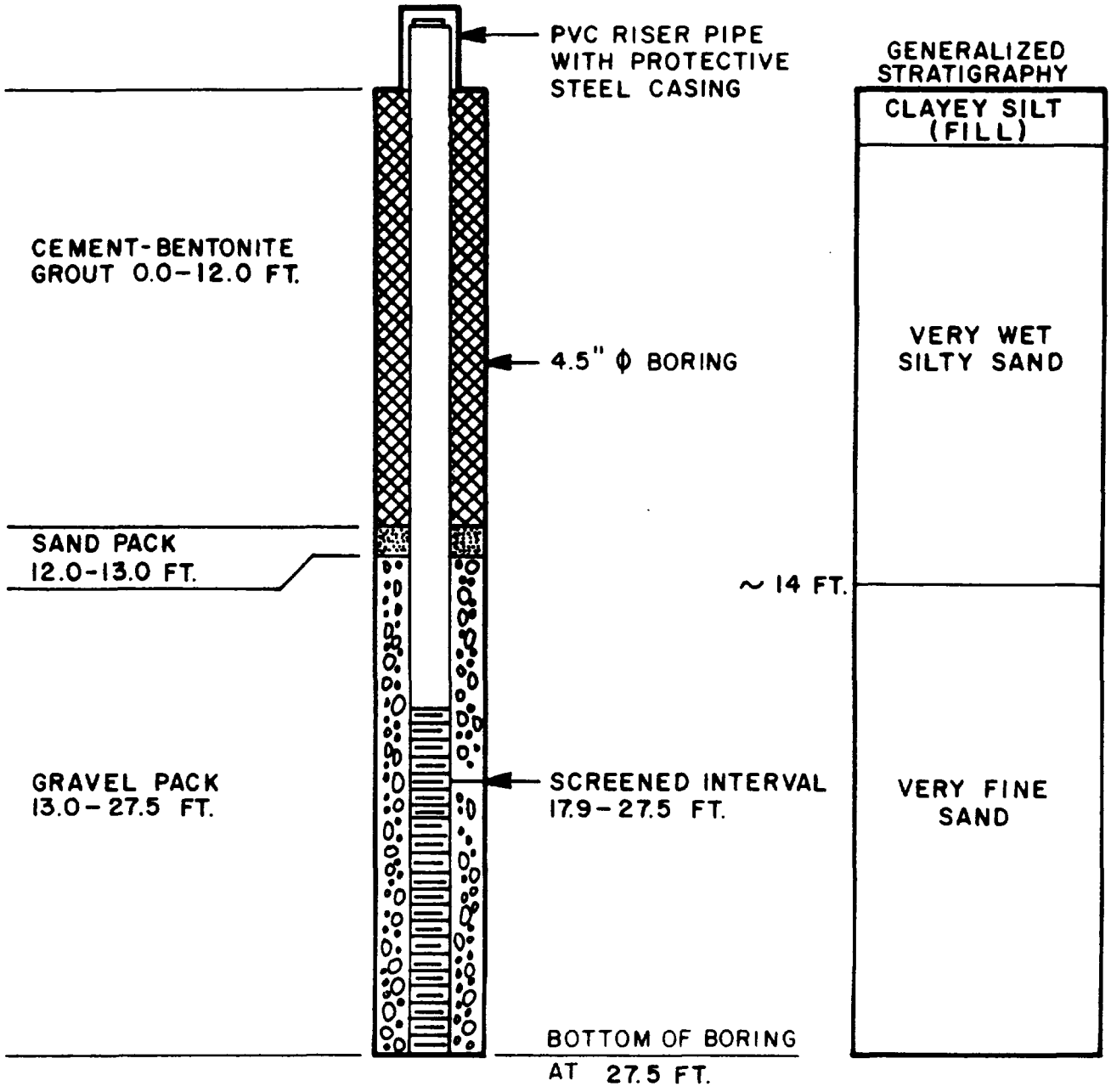
INSTALLATION DETAILS
PIEZOMETER PZ-4

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

DRAWN BY	CHECKED BY	DRAWING NUMBER
RW 10-13-83	LRS 1-9-84 / SLH 1-9-84	X83-1676-A5



NOTES:

1. RISER PIPE IS 2 IN. I.D. SCHEDULE 40 PVC PIPE.
2. SCREEN IS 2 IN. ID PVC PIPE CONTINUOUS SLOT SCREEN (0.006 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS SEALED WITH A THREADED PIPE CAP.
4. ELEVATION OF TOP OF RISER 424.17 FT.
5. ELEVATION OF WATER LEVEL 409.37 FT.
6. WATER LEVEL READING ON 9-14-83.

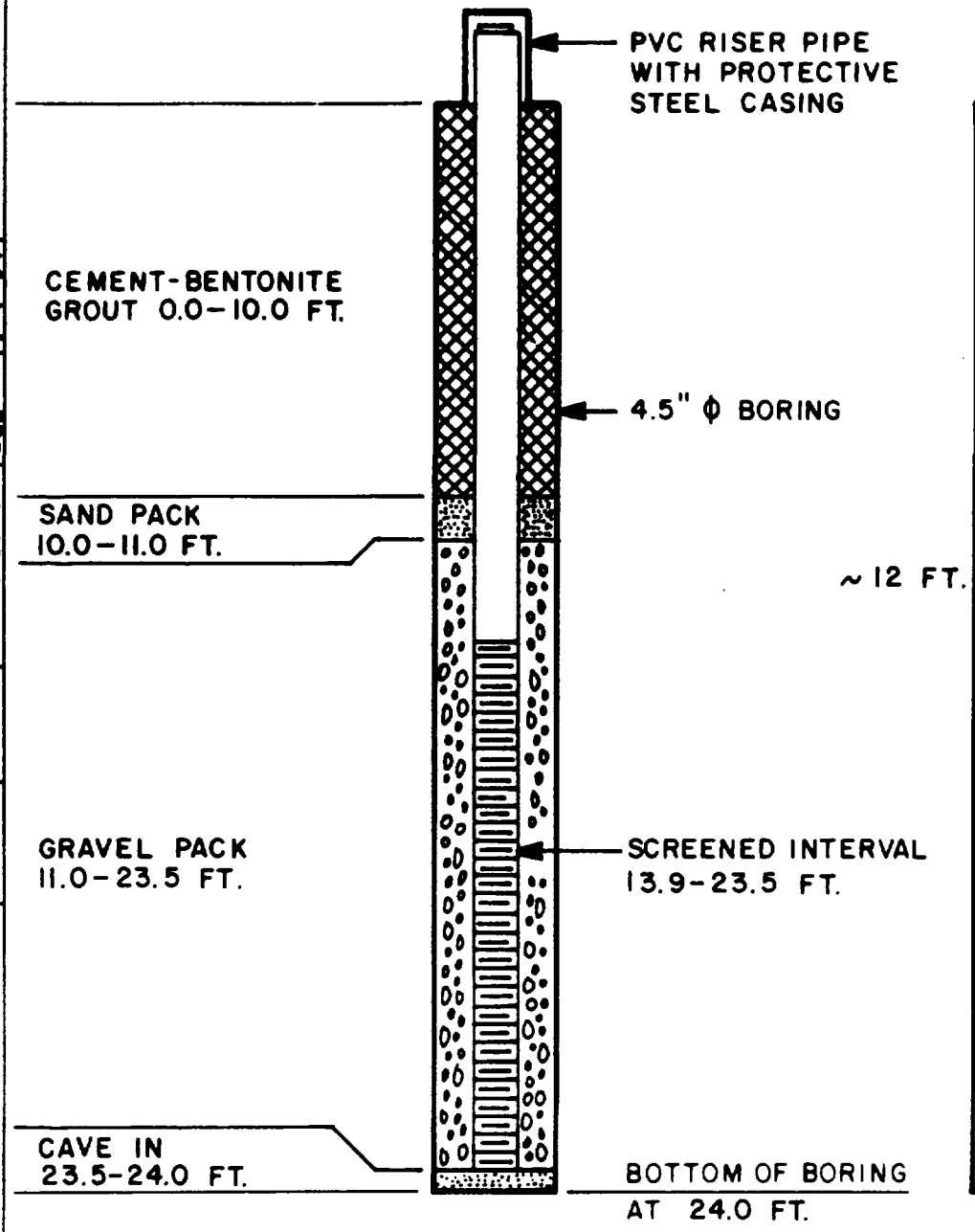
INSTALLATION DETAILS
PIEZOMETER PZ-5

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

DRAWN BY	CHECKED BY	DRAWING NUMBER
RW 10-13-83	APPROVED BY 1-9-84 LRS 1-9-84	X83-1676-A6



NOTES:

1. RISER PIPE IS 2 IN. I.D. SCHEDULE 40 PVC PIPE.
2. SCREEN IS 2 IN. ID PVC PIPE CONTINUOUS SLOT SCREEN (0.006 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS SEALED WITH A THREADED PIPE CAP.
4. ELEVATION OF TOP OF RISER 419.33 FT.
5. ELEVATION OF WATER LEVEL 405.48 FT.
6. WATER LEVEL READING ON 9-14-83.

INSTALLATION DETAILS
PIEZOMETER PZ-6

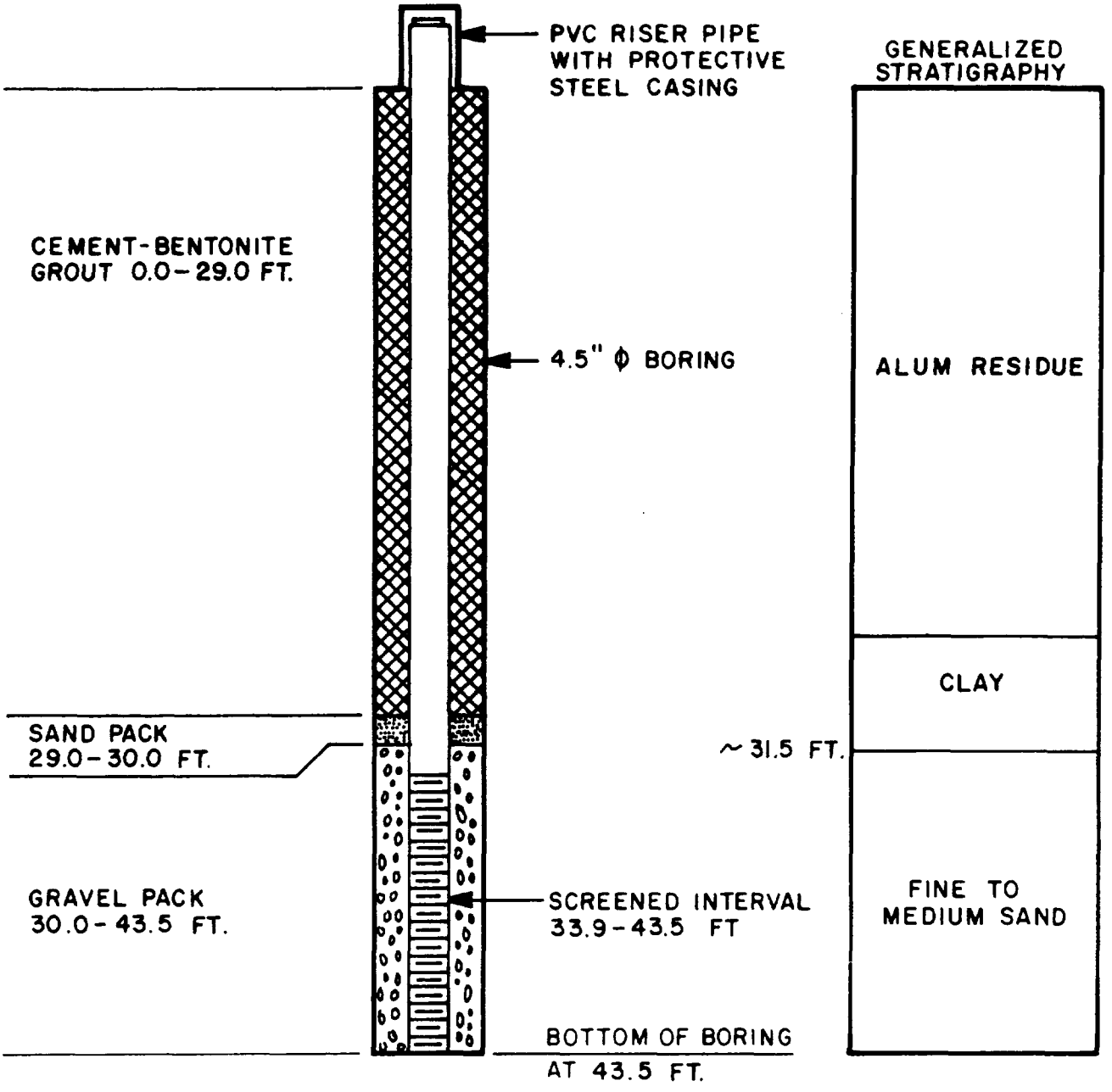
PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

DRAWN BY	RW 10-13-83	CHECKED BY	LRS 1-9-84
		APPROVED BY	3LH 1-9-84

DRAWING NUMBER X83-1676-A7



NOTES

1. RISER PIPE IS 2 IN. I.D. SCHEDULE 40 PVC PIPE.
2. SCREEN IS 2 IN. ID PVC PIPE CONTINUOUS SLOT SCREEN (0.006 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS SEALED WITH A THREADED PIPE CAP.
4. ELEVATION OF TOP OF RISER 442.35 FT.
5. ELEVATION OF WATER LEVEL 405.70 FT.
6. WATER LEVEL READING ON 9-15-83.

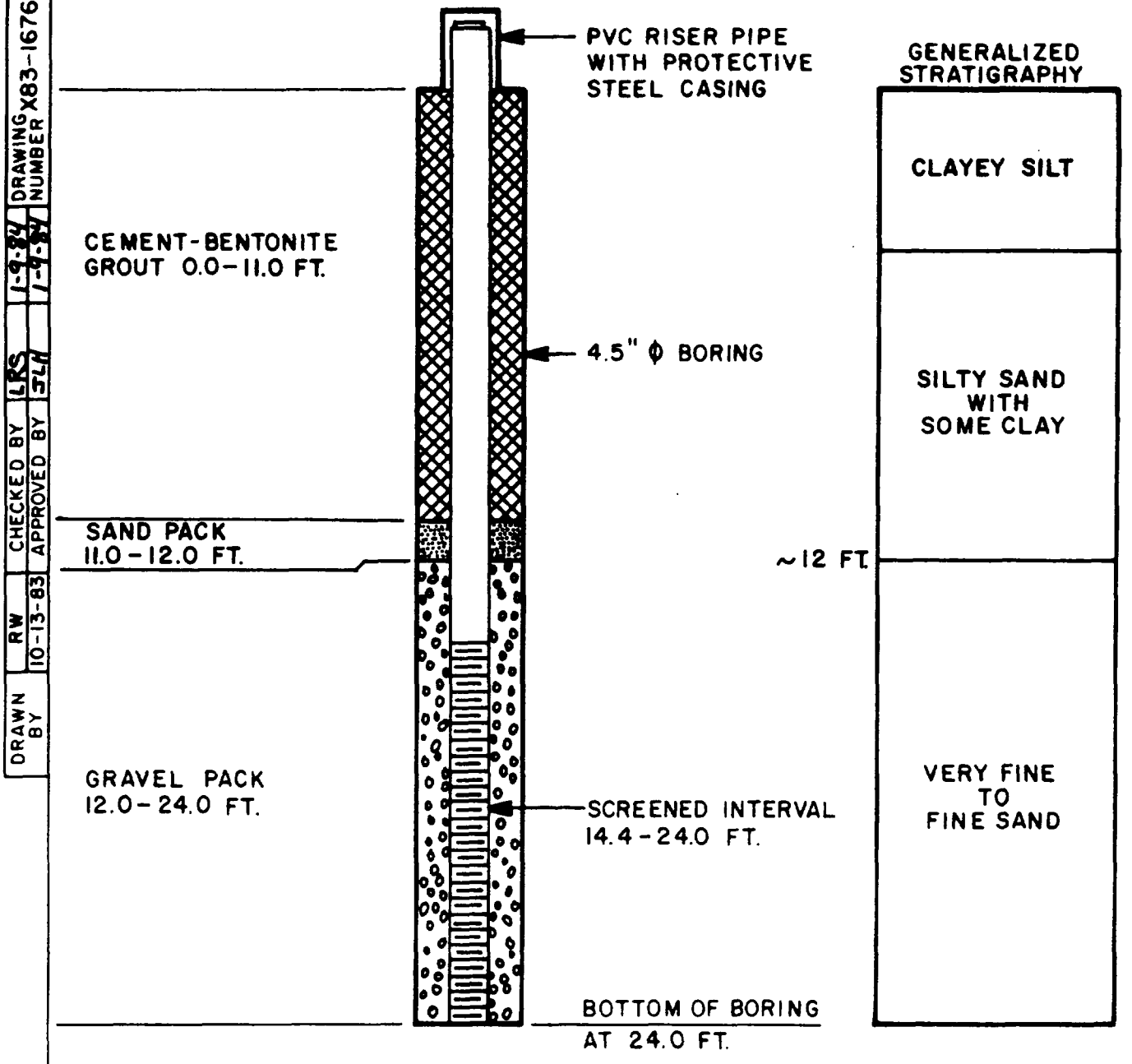
INSTALLATION DETAILS
PIEZOMETER PZ-7

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

DRAWING NUMBER	X83-1676-A8
	1-9-84
	1-9-84
CHECKED BY	LRS
APPROVED BY	SLH
	10-13-83
DRAWN BY	RW



NOTES:

1. RISER PIPE IS 2 IN. I.D. SCHEDULE 40 PVC PIPE.
2. SCREEN IS 2 IN. ID PVC PIPE CONTINUOUS SLOT SCREEN (0.006 IN. SLOT SIZE).
3. LOWER END OF SCREEN IS SEALED WITH A THREADED PIPE CAP.
4. ELEVATION OF TOP OF RISER 423.75 FT.
5. ELEVATION OF WATER LEVEL 404.95 FT.
6. WATER LEVEL READING ON 9-15-83.

INSTALLATION DETAILS
PIEZOMETER PZ-8

PREPARED FOR

ALLIED CHEMICAL COMPANY
EAST ST. LOUIS WORKS
EAST ST. LOUIS, IL.

D'APPOLONIA

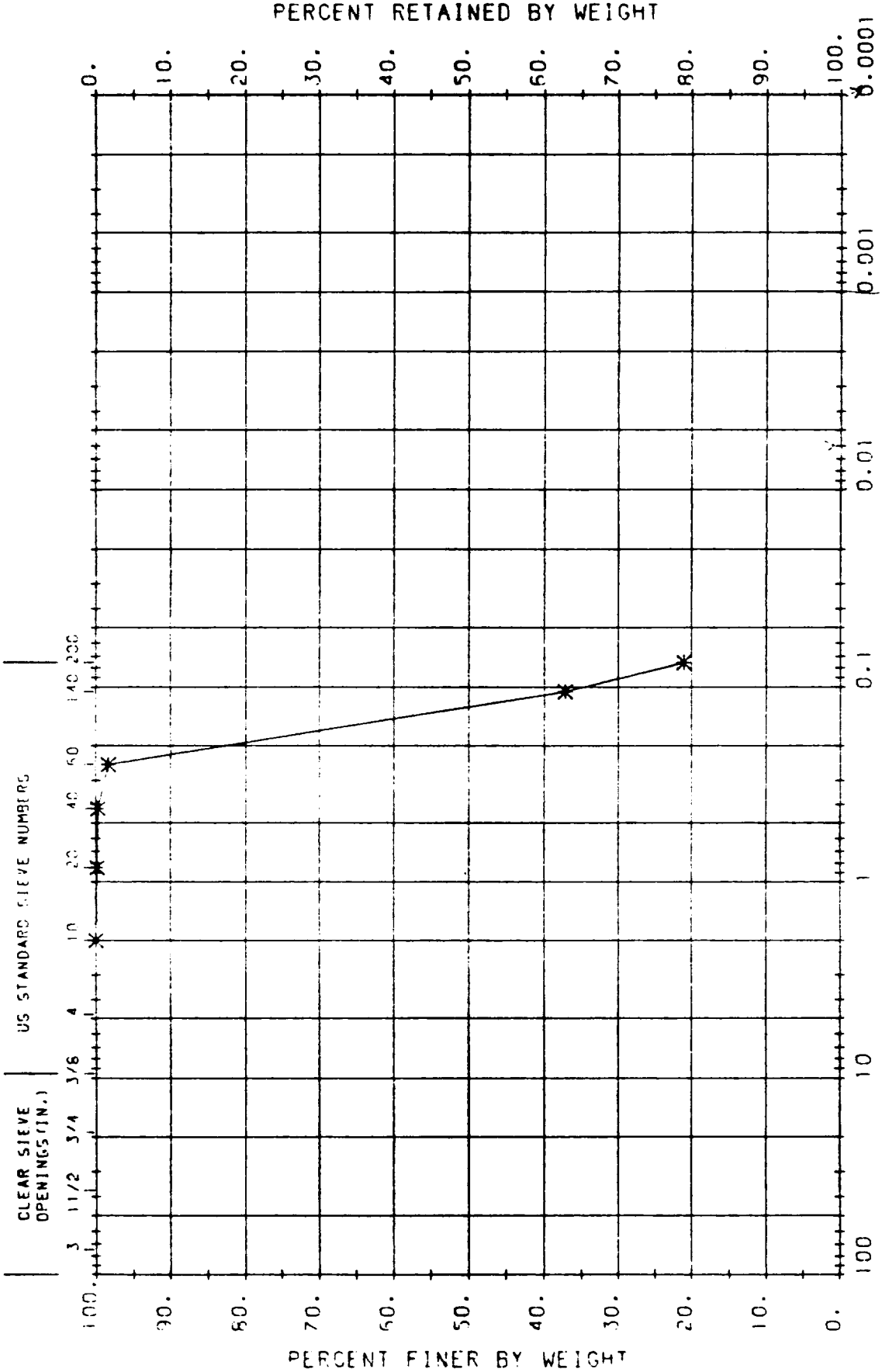
APPENDIX C

GRAIN-SIZE DISTRIBUTION

GRAIN SIZE ANALYSIS

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW



BORING	SAMPLE	DEPTH	SOIL DESCRIPTION	USCS	WC%	CU	CZ
PZ-2	S-2	29.0-30.5 FT	GRAY FINE SAND SOME SILT	SM	29.9	NA	NA

* * * * GRAIN SIZE ANALYSIS * * * *

===REDUCED RESULTS===

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW BORING NO.: P2-2

SAMPLE NO.: S-2 DEPTH: 29.0-3

===SIEVE ANALYSIS===

SIEVE NO.	DIAMETER IN MM	PERCENT FINER
3.0 IN.	75.000	100.0
1.5 IN.	37.500	100.0
0.75 IN.	19.000	100.0
0.375IN.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	100.0
NO. 20	0.850	99.8
NO. 40	0.425	99.7
NO. 60	0.250	98.3
NO. 140	0.106	37.2
NO. 200	0.075	21.0

WT. OF SOIL FOR SIEVE ANALYSIS (GM)= 210.73

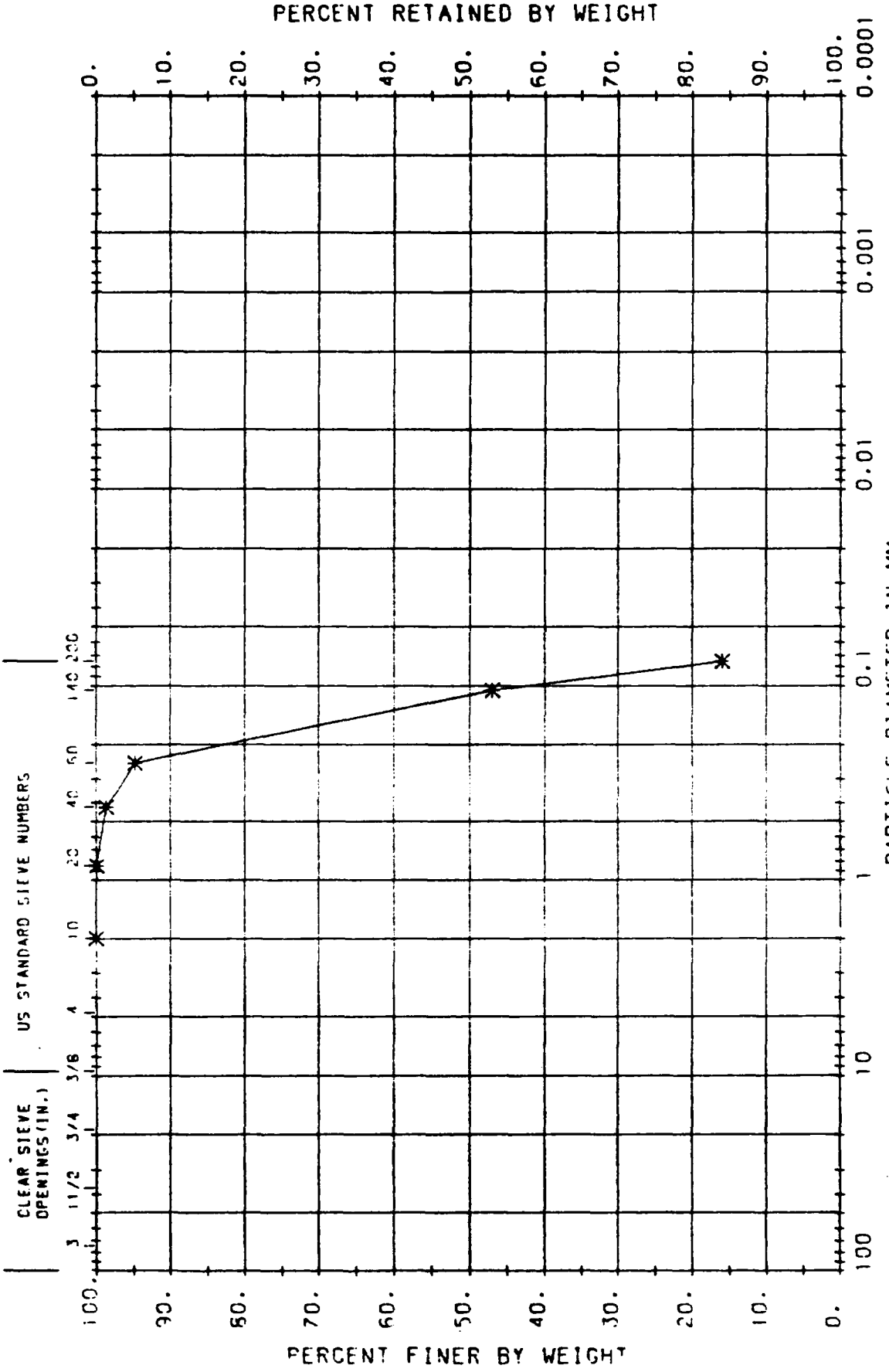
CU=NA CZ=NA

D60= 0.1460 D30= 0.0909 D10=NA

GRAIN SIZE ANALYSIS

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW



* * * * GRAIN SIZE ANALYSIS * * * *

==========REDUCED RESULTS==========

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW BORING NO.: PZ-3

SAMPLE NO.: S-3 DEPTH: 39.0-40.5 FT

===SIEVE ANALYSIS===

SIEVE NO.	DIAMETER IN MM	PERCENT FINER
3.0 IN.	75.000	100.0
1.5 IN.	37.500	100.0
0.75 IN.	19.000	100.0
0.375IN.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	100.0
NO. 20	0.850	99.9
NO. 40	0.425	98.6
NO. 60	0.250	94.8
NO. 140	0.106	47.0
NO. 200	0.075	15.9

WT. OF SOIL FOR SIEVE ANALYSIS (GM)= 171.63

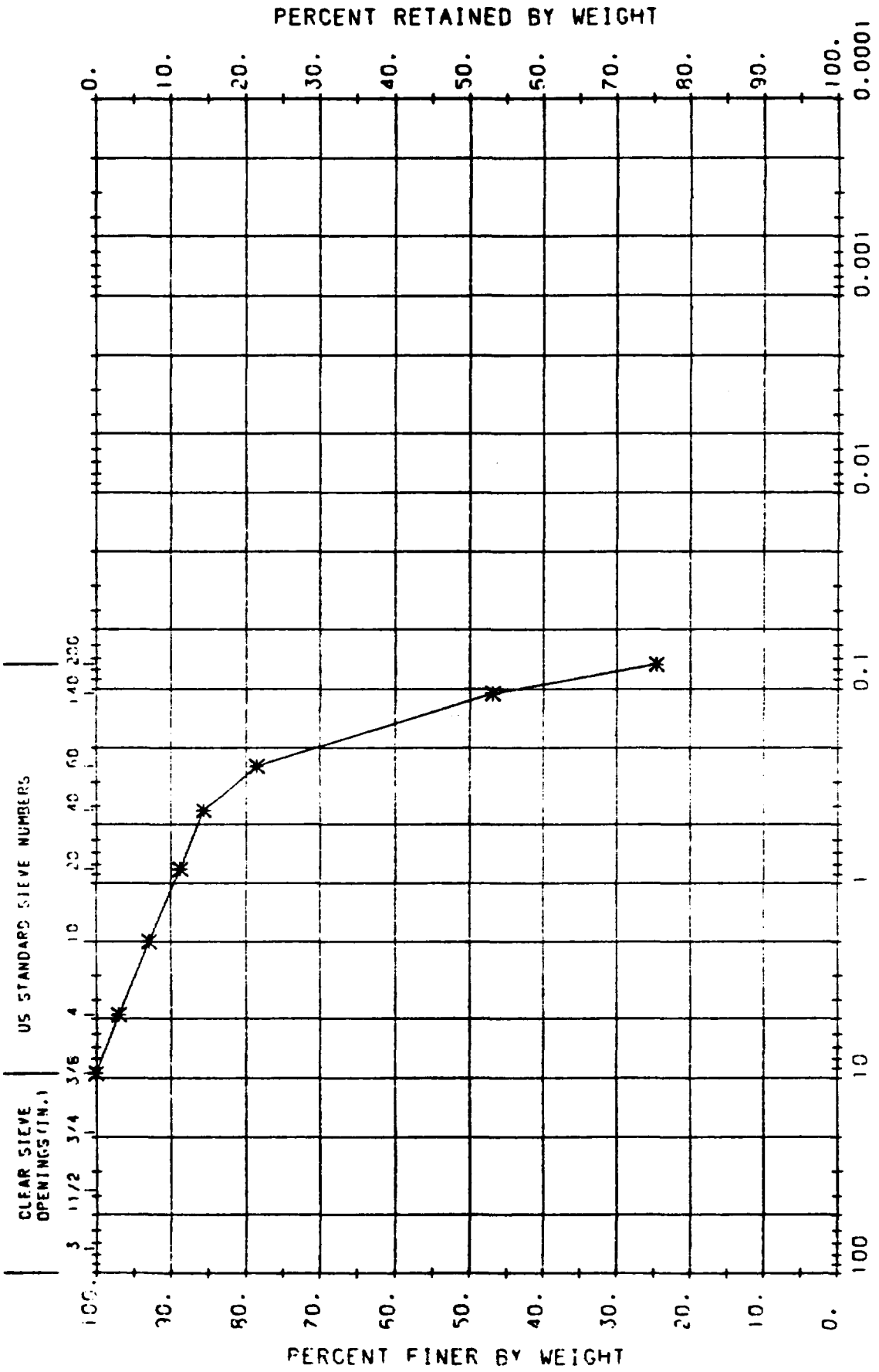
CU=NA CZ=NA

D60= 0.1338 D30= 0.0877 D10=NA

GRAIN SIZE ANALYSIS

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW



COBBLES	GRAVEL		SAND			SILT AND CLAY	
	COARSE	FINE	COARSE	MEDIUM	FINE	SILT SIZE	CLAY SIZE

BORING	SAMPLE	DEPTH	SOIL DESCRIPTION	USCS	WC%	CU	CZ
PZ-4	S-3	44.0-45.5 FT	GRAY FINE SAND SOME SILT	SM	26.1	NA	NA

*

*** * * * GRAIN SIZE ANALYSIS * * * ***

--------REDUCED RESULTS--------

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW **BORING NO.:** PZ-4

SAMPLE NO.: S-3 **DEPTH:** 44.0-45.5 FT

---SIEVE ANALYSIS---

SIEVE NO.	DIAMETER IN MM	PERCENT FINER
3.0 IN.	75.000	100.0
1.5 IN.	37.500	100.0
0.75 IN.	19.000	100.0
0.375IN.	9.500	100.0
NO. 4	4.750	97.0
NO. 10	2.000	92.9
NO. 20	0.850	88.7
NO. 40	0.425	85.6
NO. 60	0.250	78.5
NO. 140	0.106	46.9
NO. 200	0.075	24.6

WT. OF SOIL FOR SIEVE ANALYSIS (GM)= 168.24

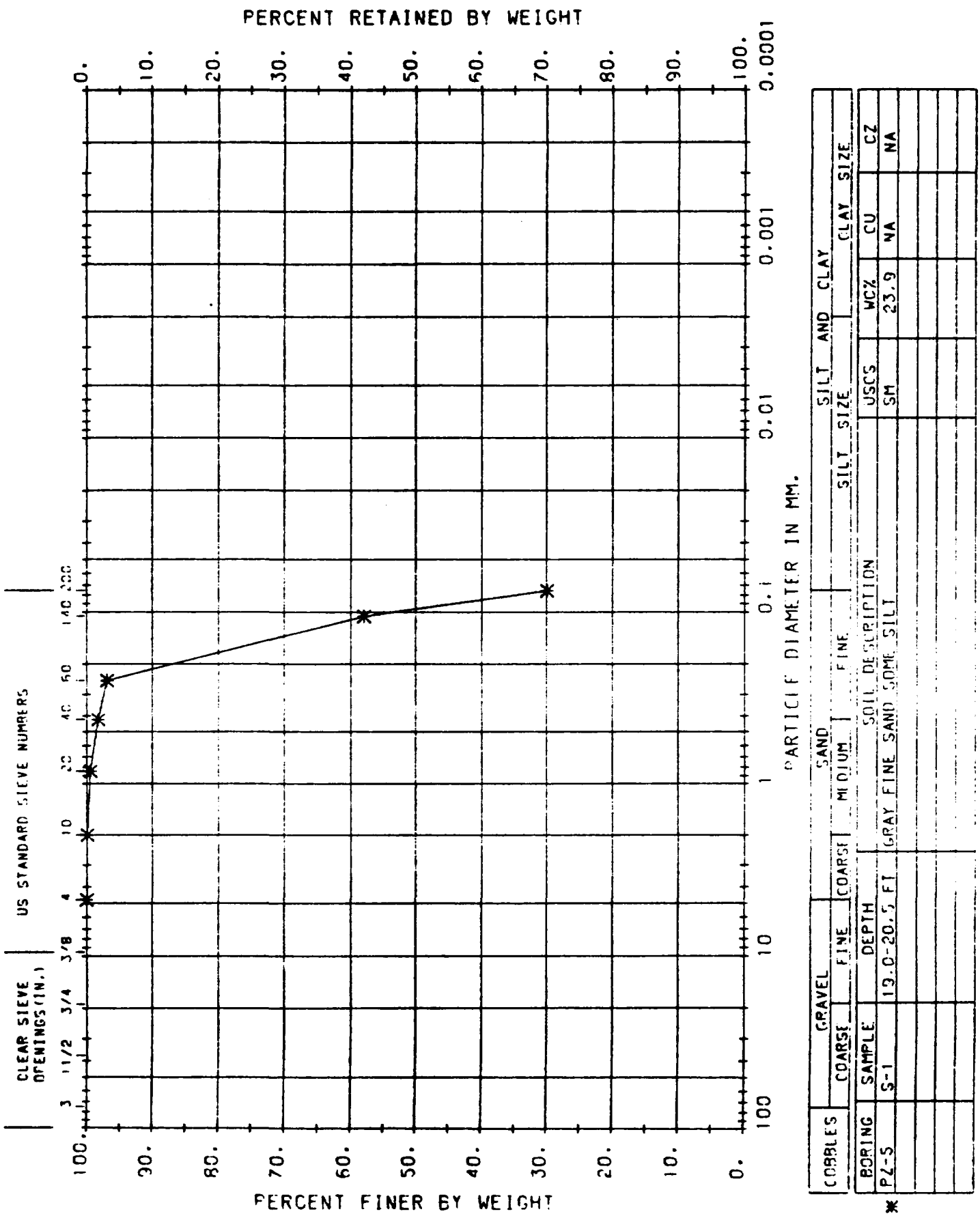
CU=NA CZ=NA

D60= 0.1512 D30= 0.0816 D10=NA

GRAIN SIZE ANALYSIS

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW



* * * * GRAIN SIZE ANALYSIS * * * *

==========REDUCED RESULTS==========

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW BORING NO.: PZ-5

SAMPLE NO.: S-1 DEPTH: 19.0-20.

===SIEVE ANALYSIS===

SIEVE NO.	DIAMETER IN MM	PERCENT FINER
3.0 IN.	75.000	100.0
1.5 IN.	37.500	100.0
0.75 IN.	19.000	100.0
0.375IN.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	99.9
NO. 20	0.850	99.4
NO. 40	0.425	98.2
NO. 60	0.250	96.9
NO. 140	0.106	58.0
NO. 200	0.075	29.9

WT. OF SOIL FOR SIEVE ANALYSIS (GM)= 176.03

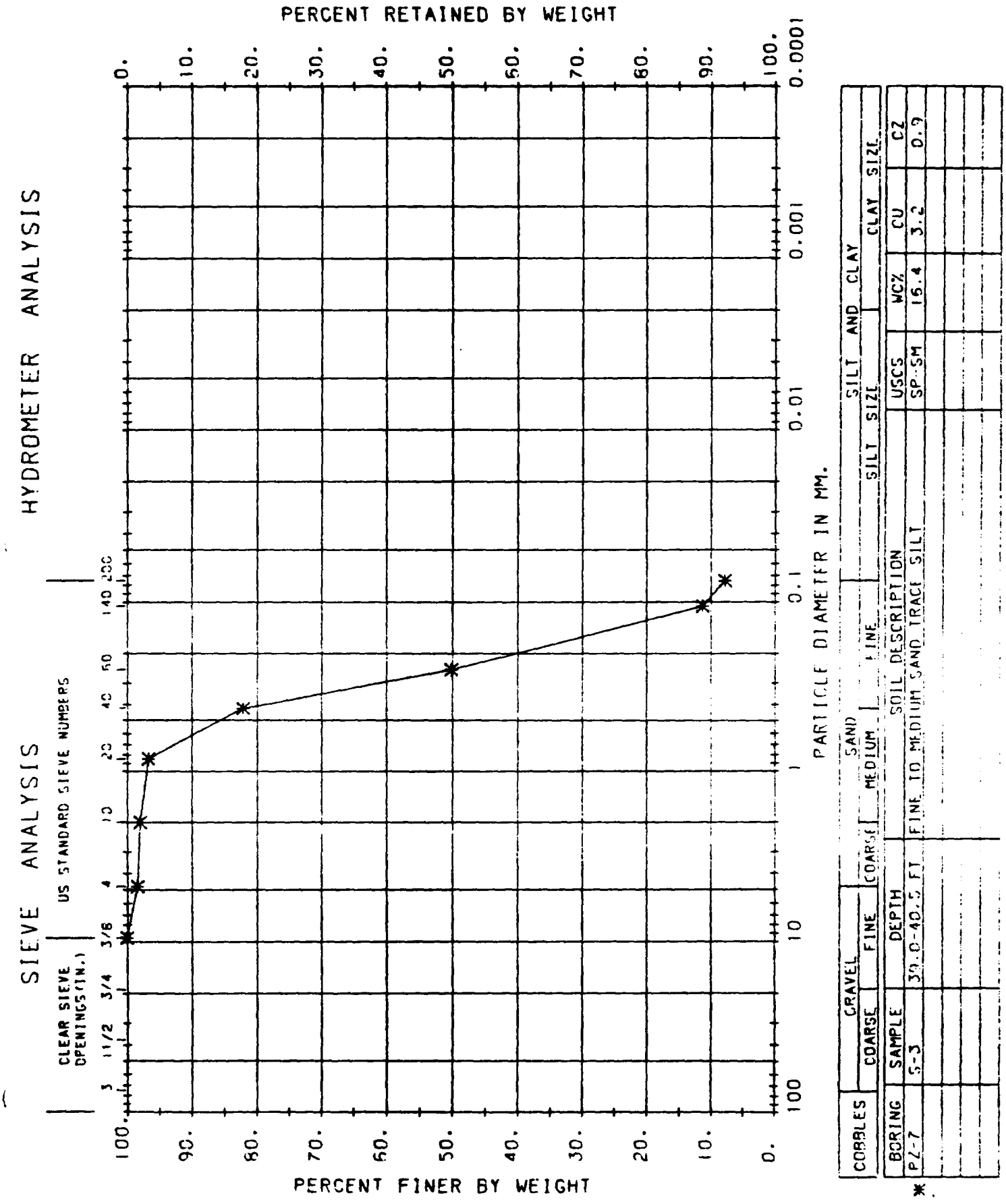
CU=NA CZ=NA

D60= 0.1108 D30= 0.0751 D10=NA

GRAIN SIZE ANALYSIS

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW



BORING	SAMPLE	DEPTH	SOIL DESCRIPTION	USCS	WC%	CU	CZ
PZ-7	S-3	39.0-40.5 FT	FINE TO MEDIUM SAND TRACE SILT	SP-SM	16.4	3.2	0.9

*** * * * GRAIN SIZE ANALYSIS * * * ***

========REDUCED RESULTS========

PROJECT NAME:	ALLIED CHEMICAL		
PROJECT NO.:	X83-1676-DW	BORING NO.:	PZ-7
SAMPLE NO.:	S-3	DEPTH:	39.0-4

===SIEVE ANALYSIS===

SIEVE NO.	DIAMETER IN MM	PERCENT FINER
3.0 IN.	75.000	100.0
1.5 IN.	37.500	100.0
0.75 IN.	19.000	100.0
0.375IN.	9.500	100.0
NO. 4	4.750	98.4
NO. 10	2.000	98.0
NO. 20	0.850	96.7
NO. 40	0.425	82.1
NO. 60	0.250	50.1
NO. 140	0.106	11.3
NO. 200	0.075	7.8

WT. OF SOIL FOR SIEVE ANALYSIS (GM)= 113.41

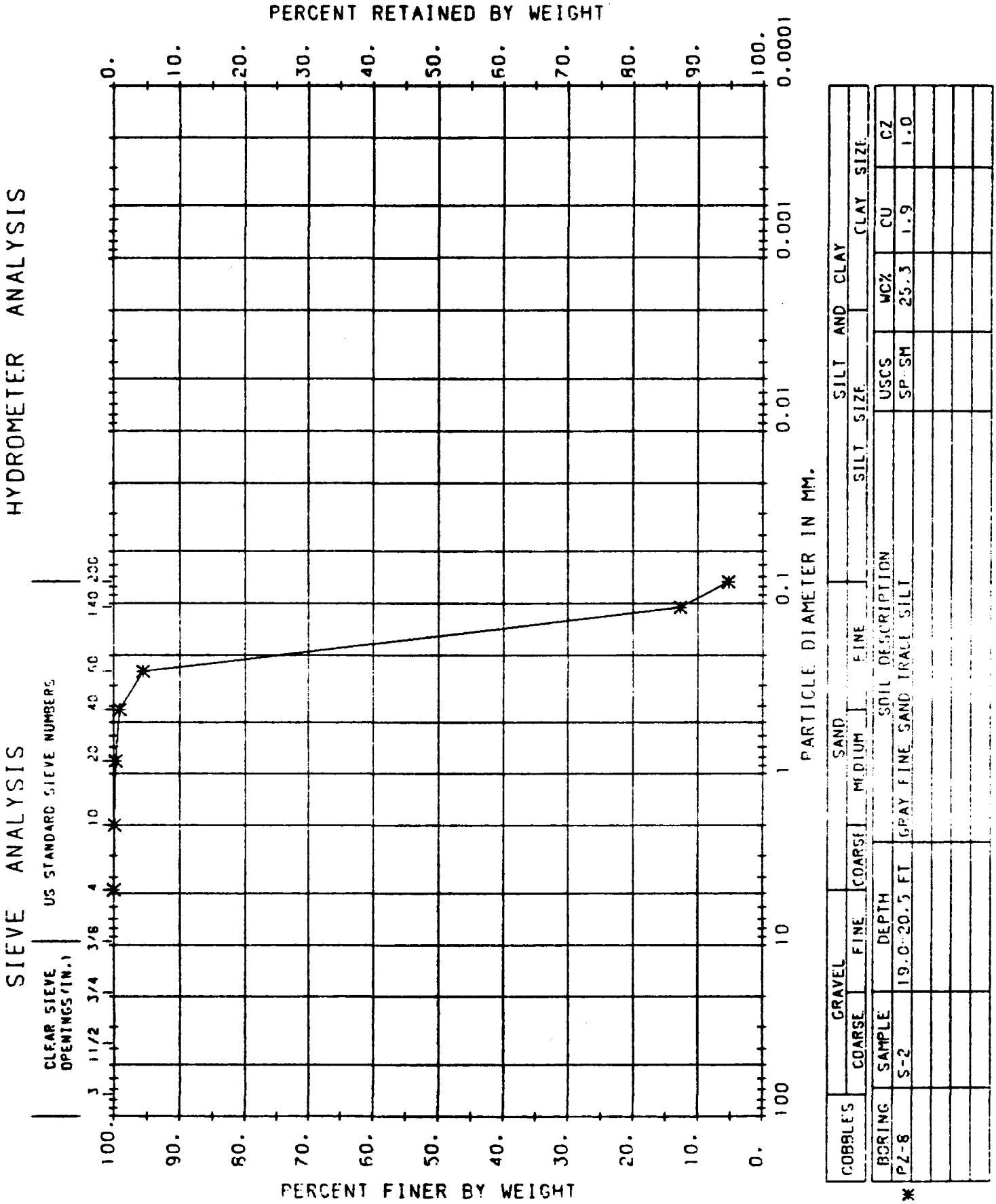
CU= 3.2 CZ= 0.9

D60= 0.2945 D30= 0.1602 D10= 0.0930

GRAIN SIZE ANALYSIS

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW



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*** * * * GRAIN SIZE ANALYSIS * * * ***

========REDUCED RESULTS========

PROJECT NAME: ALLIED CHEMICAL

PROJECT NO.: X83-1676-DW **BORING NO.:** PZ-8

SAMPLE NO.: S-2 **DEPTH:** 19.0-2

===SIEVE ANALYSIS===

SIEVE NO.	DIAMETER IN MM	PERCENT FINER
3.0 IN.	75.000	100.0
1.5 IN.	37.500	100.0
0.75 IN.	19.000	100.0
0.375IN.	9.500	100.0
NO. 4	4.750	100.0
NO. 10	2.000	99.9
NO. 20	0.850	99.7
NO. 40	0.425	99.1
NO. 60	0.250	95.6
NO. 140	0.106	12.7
NO. 200	0.075	5.3

WT. OF SOIL FOR SIEVE ANALYSIS (GM)= 240.55

CU= 1.9 CZ= 1.0

D60= 0.1729 D30= 0.1267 D10= 0.0933

1

=========LABORATORY DATA========

PROJECT NAME	PROJECT NUMBER
ALLIED CHEMICAL	X83-1676-DW

BORING NO.	SAMPLE NO.	DEPTH
PZ-8	S-2	19.0-20.5 FT

ANALYSIS TYPE	SOIL TYPE	READ SOIL DESCR.	READ USCS	READ WC	READ PI&LL	SIEVE SIZES	PLOT START	PLOT SIZE
1	1	1	1	1	0	1	5	1.00

SPECIFIC GRAVITY (Assumed or Measured)	SPECIFIC GRAVITY (Dimensionless)
N/A	N/A

VISUAL DESCRIPTION (does not require checking)

APPENDIX D

CALCULATED DRAWDOWN ZONE SURROUNDING PLANT PRODUCTION WELL

APPENDIX D

CALCULATED DRAWDOWN ZONE SURROUNDING PLANT PRODUCTION WELL

APPROXIMATE DRAWDOWN (S)[1,2]

DAYS CONTINUAL PUMPING (t)	RADIUS OF POTENTIAL DRAWDOWN ZONE (r) (feet)	WELL FUNCTION PARAMETER (u)	WELL FUNCTION FACTOR W(u)	CALCULATED DRAWDOWN (S) (feet)
1	1.5	5.0×10^{-4}	7.02	57[3]
	5	5.5×10^{-3}	4.63	38
	50	5.5×10^{-1}	0.50	4.1
	200	8.8×10^{0}	1.61×10^{-5}	1.3×10^{-4}
5	1.5	9.9×10^{-5}	8.64	70[3]
	5	1.1×10^{-3}	6.25	51
	50	1.1×10^{-1}	1.75	14
	200	1.8×10^{0}	0.069	0.6

(1) $S = \frac{Q_w}{4\pi T} W(u)$; Reference: Bear, J., 1979, Hydraulics of Groundwater, McGraw-Hill, 569 pp.

where

S = calculated drawdown of water level in aquifer below initial nonpumping level.

Q_w = 28,880 ft^3/day (150 gpm) = pumping rate.

T = 283 ft^2/day (100 feet saturated thickness; 10^{-3} cm/s permeability) = transmissivity.

W(u) = well function.

$u = \frac{S_y r^2}{4Tt}$

S_y = 0.25 (typical for sand) = specific yield.

r = radial distance from centerline of well.

t = elapsed time from start of pumping.

(2) Computed drawdowns near the well are approximate because well is screened in only lower 25 feet of aquifer.

(3) Number represents approximate drawdown in pumping well. Well diameter is three feet.

WATER SURFACE AREA DETERMINATION
DRAWING MAYBE FOUND WITH PLANS

SETTLING POND WATER BALANCE STUDY

CONDUCTED AT ALLIED CHEMICAL - EAST ST. LOUIS WORKS

FEBRUARY, 1984

S.K.SHOGREN

CONTENTS

POND WATER BALANCE

Flow measurements were initiated on Thursday, January 26, 1984 and concluded on Wednesday, February 8, 1984. Total time elapsed during the period was thirteen days, two minutes. Surveyors hired to establish the pond water elevation and area at the start of the period and again at the conclusion determined the pond contained 7,952 cubic feet more water at the conclusion of the test than it did at the start.

Flow to the pond was measured at the plant as described in "Flow to Pond" and "Pond Flow Measurement Data." A sample and temperature reading was obtained at the pond end of the pipeline at each sampling time. Slurry solids content was determined by individual settling tests in graduated cylinders. To determine evaporation area, measurements of the exposed solid portion of the pond over which the water flowed were made each day. Weather information was recorded at sampling times from weather radio broadcasts at Lambert Field in St. Louis.

Pond discharge volumes were obtained by drum catch and stopwatch. Three separate pipelines were used for discharge and two drum volumes (57.14 gal. each) were caught from each pipe during sampling.

Samples were collected on a predetermined computer generated random time schedule. The random sampling was important to derive an average flow value for the plant because of variability due to intermittent equipment operation. A total of 38 sampling times occurred during the thirteen days. Results of flow measurements indicate essentially all water going to the pond can be accounted for and there is no significant leakage from the pond.

Total Slurry To Pond.....	5,459,339 gallons
-minus-	
Settled Solids Remaining In Pond.....	354,857 gallons
Water Discharged From Pond.....	4,988,223 gallons
Water Volume Remaining In Pond.....	59,640 gallons
Evaporation.....	55,859 gallons
Balance	760 gallons (0.01% of total)

(Use of a calculated rather than an empirical evaporation rate would result in a balance of -4,311 gal.)

FLOW TO POND

Flow to the pond was determined by timing the water level rise in the slurry pump supply tank with the pump off. All flow to the pond is collected in the 72.5' diameter (215 gal/ft) tank. Because of variability due to intermittent operation of sumps, processes and miscellaneous sources, 38 flow measurements were done over a 13 day period. A computer generated random time schedule was followed during the test period in order to produce an average flow value for the period. Leakage occurring from the slurry pump packing and discharge flange connection during part of the test was estimated and subtracted from the flow measurement.

Slurry solids were determined from 38 random samples by settling in graduated cylinders and averaged 6.5% by volume over the test period. The solids volume was subtracted from the flow to determine the total flow to be accounted for. The solids settle rapidly and since the water level was maintained at a higher level during most of test period than at either the start or ending time, most of the solids settled on the area exposed when the water level was lowered to the final survey elevation.

291.6 gpm (average pumping rate) X 18722 minutes = 5,459,335 gallons of slurry to pond

5,459,335 X 6.5% settled solids = 354,857 gallons of settled solids

5,459,339 - 354,857 = 5,104,478 gallons of water to account for

POND FLOW MEASUREMENT DATA

ALLIED CHEMICAL - EAST ST. LOUIS WORKS

DATE	DAY	TIME	MUD TANK VOLUME (sec/ft)	PUMP LEAKAGE (gpm)	FLOW TO POND (gpm)	POND SAMPLE TIME	SETTLED SOLIDS CONTENT	TEMPERATURE OF SLURRY AT POND(F)	EVAPORATION AREA (EXPOSED SOLIDS-sq yd)	WEATHER DATA (Lambert Field) TEMP(F)	WIND/FROM	HUMID	SKY
1/26/84	THURS	0910	41.55	3	307.4	0938	8.2%	91.4	5400	34	8 / S	96%	CLR
1/26/84	THURS	1925	43.54	3	293.2	1934	3.3%	79.7	5400	45	12 / S	68%	CLR
1/27/84	FRI	0743	78.17	3	162.0	0759	7.7%	86.0	5400	31	17 / NW	92%	CLDY
1/27/84	FRI	0900	38.56	3	331.5	0910	3.0%	64.4	5400	30	15 / W	84%	CLDY
1/27/84	FRI	1725	30.42	3	421.0	1716	13.1%	87.8	5400	33	7 / N	70%	PTCL
1/28/84	SAT	0410	38.99	3	327.8	0400	1.6%	82.4	3600	29	10 / S	96%	CLDY
1/28/84	SAT	0810	39.77	3	321.3	0806	8.6%	67.1	3600	31	14 / S	96%	RAIN
1/28/84	SAT	1755	36.52	3	350.1	1745	5.7%	79.7	2700	46	15 / W	68%	PTCL
1/29/84	SUN	0512	36.97	3	345.9	0501	4.0%	78.8	2700	32	14 / NW	92%	CLDY
1/29/84	SUN	1254	49.96	3	255.1	1245	14.4%	89.6	2250	40	8 / SW	74%	CLDY
1/29/84	SUN	1825	35.76	3	357.7	1814	8.1%	75.2	2250	44	18 /SSE	79%	CLDY
1/30/84	MON	0311	56.48	3	225.3	0301	8.7%	51.8	50	32	31641/W	85%	SNOW
1/30/84	MON	0855	60.59	3	209.9	0915	3.4%	53.6	50	25	30640/NW	81%	SNOW
1/30/84	MON	1847	38.77	3	329.7	1820	5.8%	90.5	75	27	20 / NW	74%	CLDY
1/31/84	TUES	0650	36.34	3	351.9	0700	6.2%	91.4	850	23	7 / S	81%	CLDY
1/31/84	TUES	1424	59.34	3	214.3	1434	13.2%	95.0	1050	47	15 / W	46%	SUNY
1/31/84	TUES	1636	37.59	3	340.1	1643	5.3%	102.2	1050	47	8 / NW	51%	PTCL
2/01/84	WED	0157	36.82	3	347.3	0125	6.4%	93.2	1500	32	5 / W	92%	CLR
2/01/84	WED	1446	41.26	5	307.6	1434	5.9%	96.8	2700	57	12 / SE	42%	SUNY
2/01/84	WED	1642	41.02	5	309.4	1638	5.5%	91.4	2700	57	12 / SE	47%	SUNY
2/02/84	THURS	1300	78.85	5	158.6	1225	11.8%	59.0	3420	53	7 / S	60%	RAIN
2/02/84	THURS	2350	49.37	5	256.2	2339	1.6%	102.2	1020	40	9 / W	79%	RAIN
2/03/84	FRI	0445	44.34	10	280.9	0428	0.8%	96.8	1020	33	9 / W	85%	CLDY
2/03/84	FRI	1640	44.06	10	282.7	1512	5.6%	93.2	1020	53	14 /WSW	44%	PTCL
2/03/84	FRI	2127	44.00	10	283.1	2115	4.1%	75.2	1020	41	12 / NW	71%	CLR
2/04/84	SAT	0727	49.91	10	248.4	0715	6.5%	71.6	4000	34	14 / W	82%	PTCL
2/04/84	SAT	1130	44.44	10	280.2	1116	1.0%	82.4	4000	36	18 / W	69%	PTCL
2/05/84	SUN	0010	43.68	10	285.3	0023	7.4%	75.2	4000	30	20 / NW	69%	PTCL
2/05/84	SUN	0122	43.10	15	282.2	0132	7.6%	55.4	4500	29	10 / W	78%	SNOW
2/05/84	SUN	1418	45.78	15	266.7	1408	7.9%	66.2	4500	15	28G35/WNW	88%	SNOW
2/06/84	MON	0655	44.25	15	276.5	0715	5.5%	69.8	4500	2	12 / NW	66%	CLR
2/06/84	MON	1107	47.80	15	254.8	1130	7.5%	69.8	4500	11	13 / W	57%	SUNY
2/06/84	MON	2356	42.95	15	285.3	2346	4.7%	69.8	4500	10	4 / SE	80%	CLR
2/07/84	TUES	0730	38.99	0	330.8	0720	6.2%	73.4	4500	10	7 / SE	73%	CLR
2/07/84	TUES	1209	39.35	0	327.8	1158	11.8%	66.2	4500	22	12 / SE	60%	SUNY
2/07/84	TUES	1750	46.78	0	275.7	1745	8.0%	75.2	4500	30	12 / SE	60%	CLR
2/08/84	WED	0737	43.91	0	293.7	0726	5.8%	66.2	4500	25	10 / SE	76%	CLR
2/08/84	WED	0945	42.57	0	303.0	1003	6.1%	71.6	4500	27	12 / S	68%	CLR
					291.6avg		6.5%avg	78.6avg	3122avg	32.7avg			73%avg

Flow measurement period of 13 days 2 minutes. Total flow = 291.6gal X 18722min = 5,459,335 gallons.

Mud Tank Volume obtained by timing one foot rise in pump supply tank of 72.5 inch diameter (1'=215 gallons).
Flow to Pond is timed mud tank rise minus estimated pump flange and packing leakage.
Settled solids were determined on each sample in a graduated cylinder.
Slurry temperature was determined for each sample at pond end of slurry pipeline.
Evaporation area was exposed solids in pond over which slurry dispersed before entering the pond waterbody.

EVAPORATION

Evaporation from the pond waterbody was determined empirically by measuring evaporation from a bucket placed on the bank adjacent to the pond. Precipitation during the period was reported at Lambert Field, St. Louis to have been 0.12 inches. Since precipitation accumulated in the bucket as well as the pond, it was disregarded. At the end of the sampling period the bucket water level was 0.44 inches (7/16") lower. The bucket was frozen six of the test days while the pond had an ice cover only one day. No increase in surface area of the pond due to wave formation during windy conditions is included in evaporation estimates, but wave action and the lack of ice on the pond as compared to the test bucket would indicate evaporation from the pond would be higher than from the bucket. Calculation using an evaporation rate based on temperature and humidity conditions also indicate pond evaporation would be higher than experienced in the bucket. Surface area of the pond waterbody varied from a high of approximately 180,000 square feet to a low of 156,300 square feet. The final pond level survey conducted at the conclusion of the test period determined a water surface area of 162,030 square feet which is the area used to calculate evaporation.

162,030 sq.ft. X 0.44 inches = 5941 cubic feet (44,558 gallons)

Note: Using an evaporation rate of 0.002"/hour based on temperature and humidity (water = 40 degrees F, air = 32.7 degrees F, humidity = 73%), the evaporation loss would be:
162,030 X 0.002"/hr X 312 hrs = 63,192 gal + 13,500 gal precip = 49,629 gallons

During the test period, the slurry entering the pond flowed over an area of raised solids before reaching the waterbody. An average area of exposed solids was determined from daily measurements to be approximatly 28,100 square feet. The flow would sometimes spread over the solids area and sometimes flow in discrete channels. For evaporation calculation purposes, 25% of the available surface area is assumed to be the water surface area. Using the averages of weather data recorded during sample collection times (data broadcast on weather radio hourly from Lambert Field, St. Louis), evaporation rates were determined for water temperatures of 78.6 degrees F (average slurry temperature at pond) and 40 degrees F (average pond water temperature). Average air temperature and humidity values were 32.7 degrees F and 73% respectively. For a water temperature of 78.6 the evaporation rate was calculated to be 0.0145 inches/hour and for a water temperature of 40 the rate was 0.002 inches/hour. Since temperature gradients across the solids area could not be determined, the evaporation for both conditions was determined and an average value used.

78.6) 7025 sq.ft. X 0.0145"/hr = 63.66 gal/hr X 312 hrs = 19,863 gal
40.0) 7025 sq.ft. X 0.002"/hr = 1.17 gal/hr X 312 hrs = 2,740 gal

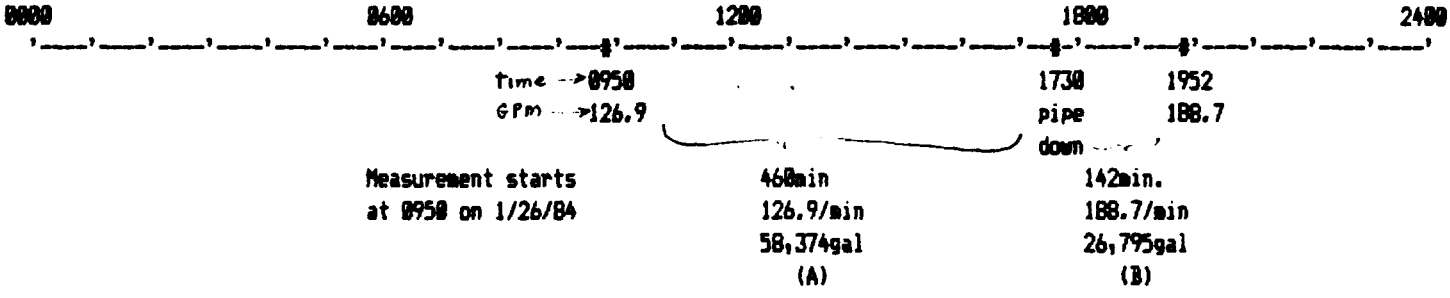
22,603 gal /2 = 11,301 gallons evaporated

TOTAL EVAPORATED = 44,558 + 11,301 = 55,859 GALLONS

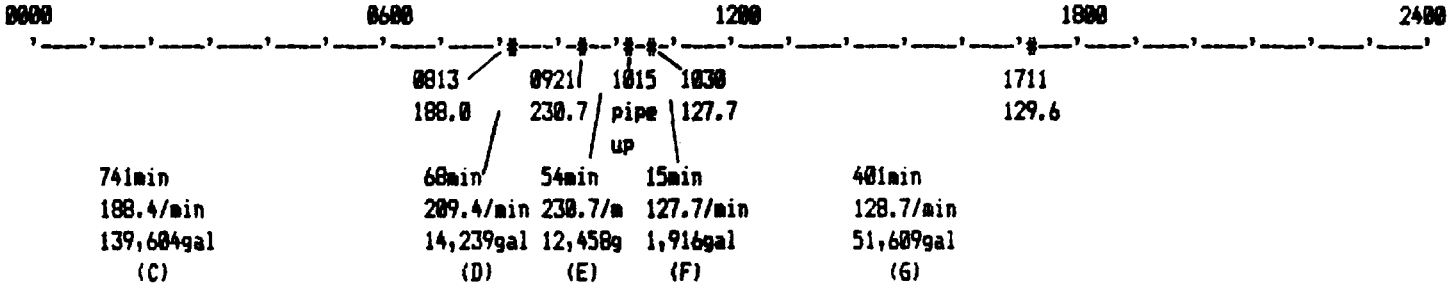
POND DISCHARGE DATA

ALLIED CHEMICAL - EAST ST. LOUIS WORKS

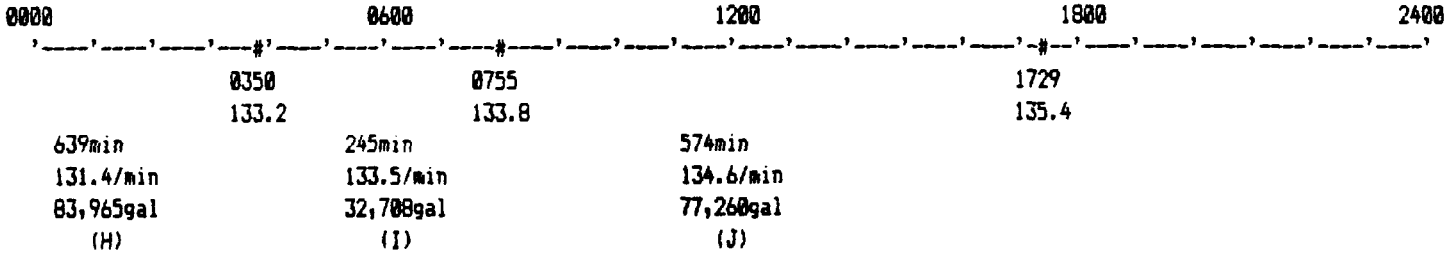
THURSDAY (1/26/84)



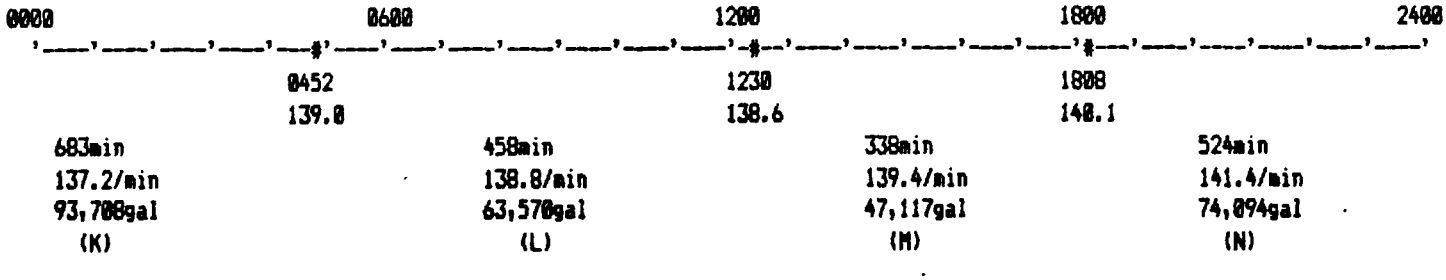
Friday (1/27/84)



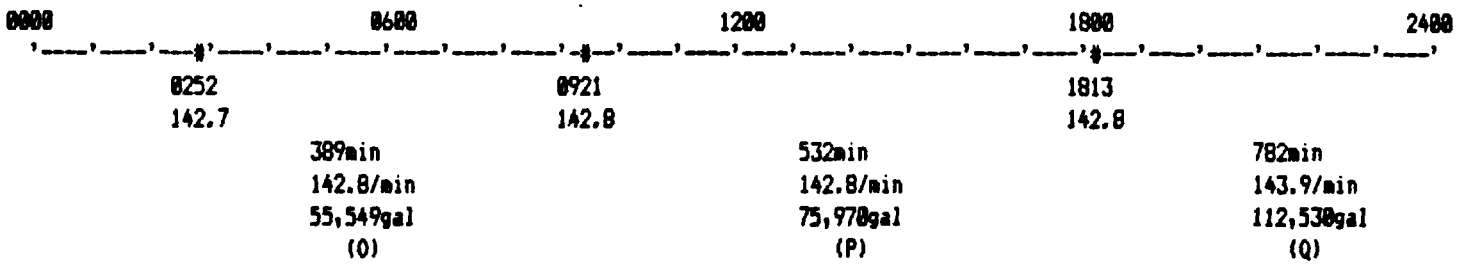
Saturday (1/28/84)



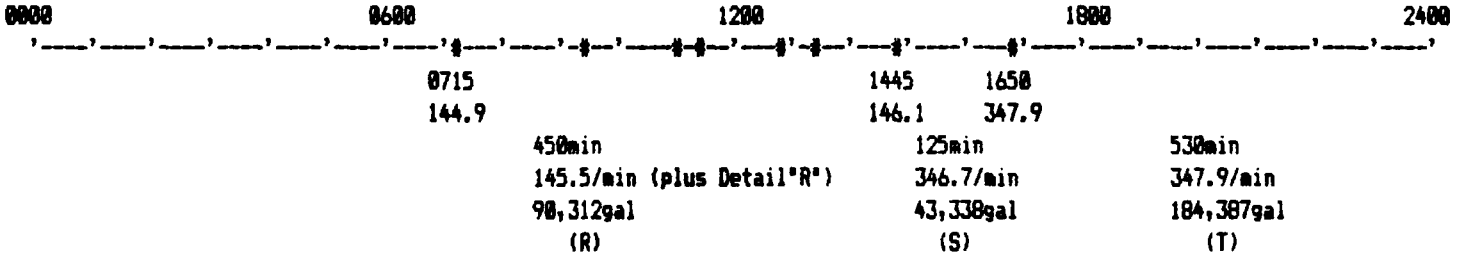
Sunday (1/29/84)



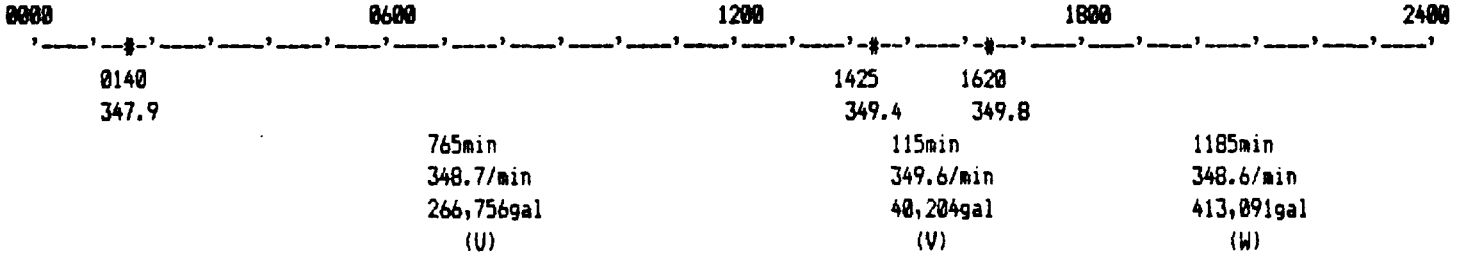
Monday (1/30/84)



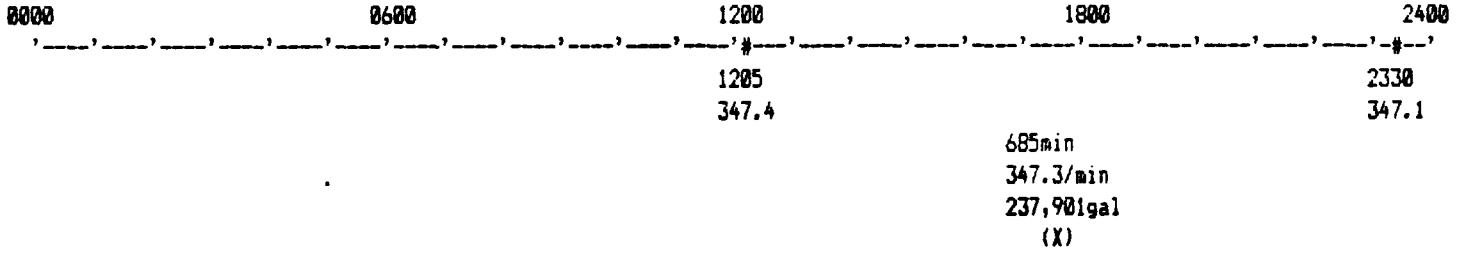
Tuesday (1/31/84)



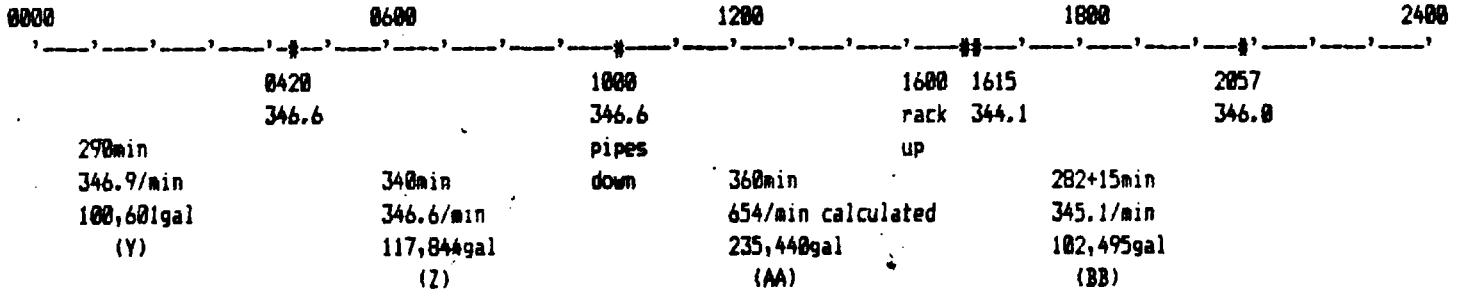
Wednesday (2/01/84)



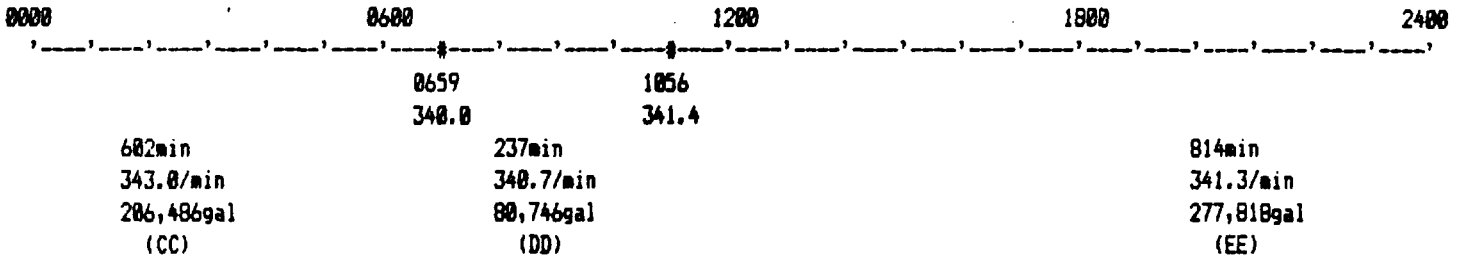
Thursday (2/02/84)



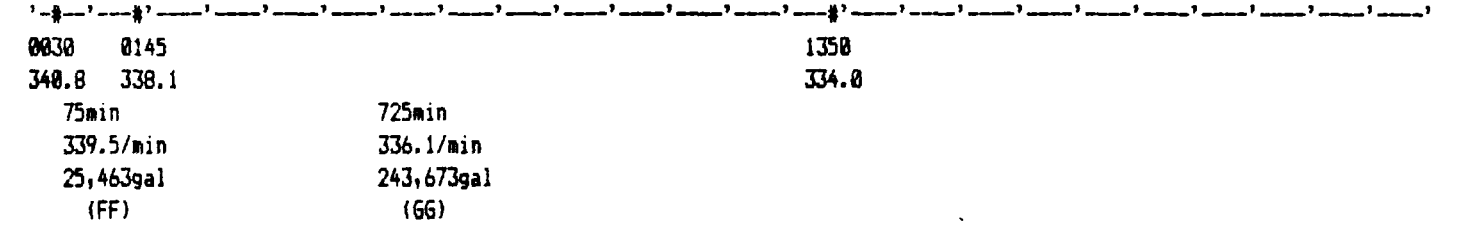
Friday (2/03/84)



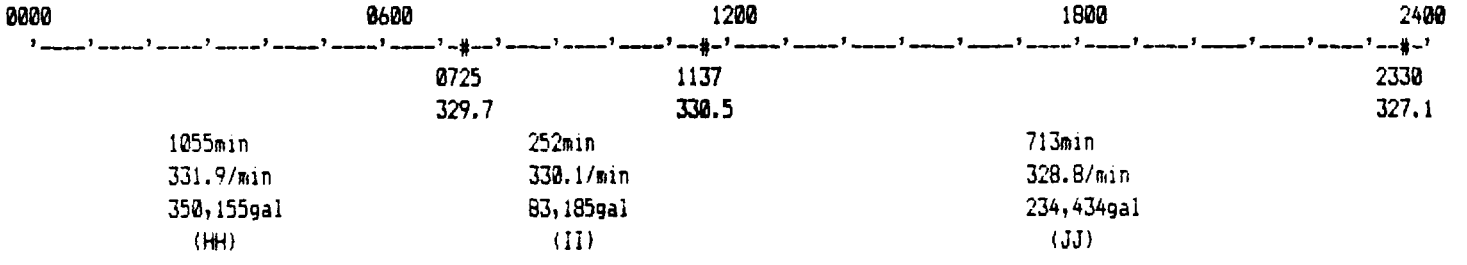
Saturday (2/04/84)



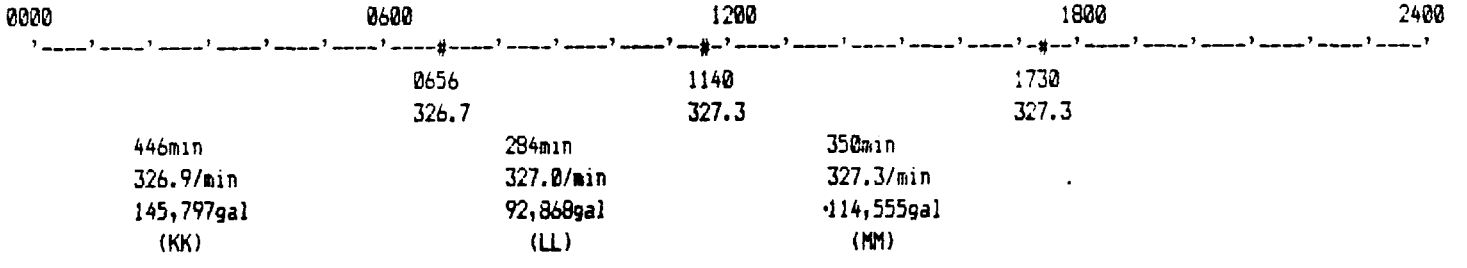
Sunday (2/05/84)



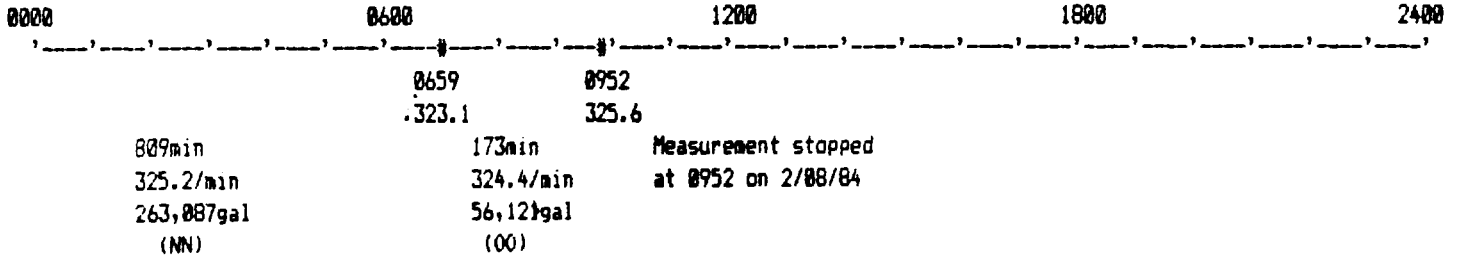
Monday (2/06/84)



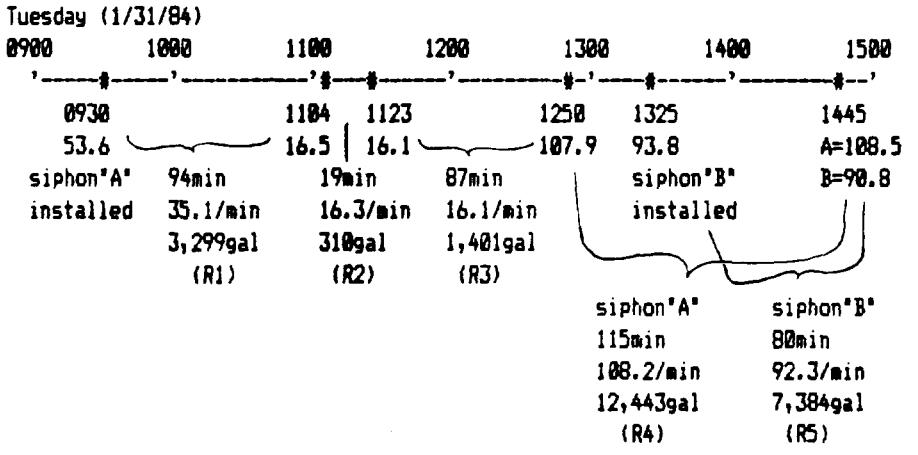
Tuesday (2/07/84)



Wednesday (2/08/84)



DETAIL "R"



POND DISCHARGE FLOW VOLUMES

(A)	58,374	(AA)	235,440
(B)	26,795	(BB)	102,495
(C)	139,604	(CC)	206,486
(D)	14,239	(DD)	80,746
(E)	12,458	(EE)	277,818
(F)	1,916	(FF)	25,463
(G)	51,609	(GG)	243,673
(H)	83,965	(HH)	350,155
(I)	32,708	(II)	83,185
(J)	77,260	(JJ)	234,434
(K)	93,708	(KK)	145,797
(L)	63,570	(LL)	92,868
(M)	47,117	(MM)	114,555
(N)	74,094	(NN)	263,087
(O)	55,549	(OO)	56,121
(P)	75,970		
(Q)	112,530		
(R)	90,312		
(S)	43,338		
(T)	184,387		
(U)	226,756		
(V)	40,204		
(W)	413,091		
(X)	237,901		
(Y)	100,601		
(Z)	117,844		

Total pond discharge = 4,988,223 gallons

ALLIED CHEMICAL
EAST ST. LOUIS WORKS
SOLIDS SEPARATION FACILITY

Present System

Insoluble clay residues are combined with process waters from the aluminum sulfate and sodium aluminum sulfate (SAS) manufacturing processes and pumped 2200 feet through a six inch HDPE pipeline to a four acre settling pond. After solids separation the pond water is decanted to a process water return ditch which flows a distance of 3200 feet around the northern periphery of the property to a return pump. From there the water is pumped back to process and used as barometric condenser cooling water before being pumped again to the pond. Other major intermittent sources pumped to the pond include emission scrubber and boom cooling waters from the SAS plant, water softener regeneration, boiler blowdown, various wash waters and stormwater. Measurements completed in February, 1984 indicated an average flow of approximately 420,000 gallons per day was being pumped to the pond during a period with no significant rainfall event. The settling pond was built in 1978 and is expected to be near solids retention capacity by the end of 1984.

A hydrogeological investigation initiated in September, 1983 and completed in January, 1984 disclosed that the northwest corner of the process water return ditch is the probable source of infiltration to groundwater. In order to prevent further degradation of the groundwater, an alternate system has been designed. The system was discussed with Messrs. McSwiggin, Kluge and Sheth at the IEPA Springfield office on February 16, 1984 and is described as follows:

New Plan Of Operation

The process water return ditch will be eliminated from the system to prevent groundwater degradation. A new pump will be installed within the pond and process waters will be returned directly to the plant through a new six inch HDPE pipeline. There will be no other discharge from the pond. Both pipelines, to and from the pond, will be buried to prevent freezing. The pump, pipeline and electrical supply will be installed and operating during 1984 provided IEPA approval is received early enough in the construction season.

When the new return pump is installed in the pond, continuous use of the return ditch will cease. Modifications to plant processes will be completed as soon as possible to

achieve a zero flow balance, but changes to plant spill containment and stormwater segregating systems will require a second construction season for completion. The current spill containment captures approximately five acres of plant surface runoff which is pumped to the settling pond. Modifications will minimize the rainfall capture area while providing maximum spill protection. Until modifications are completed, a heavy rainfall event may force some pond water to be discharged to the process water return ditch. Use of the return ditch will be avoided if possible. Modifications to plant processes, spill containment, stormwater segregating systems, and final abandonment of the process water return ditch will be completed by September 30, 1985. Upon final abandonment, process waters remaining in the ditch will be pumped to the plant and captured within the new system. In the future, the ditch will collect stormwater and may occasionally be tapped as a source of makeup water for the process.

Operation of the new system will require modifications to plant processes to assure a zero water flow balance. Tests are in progress to switch SAS roaster scrubbers and boom cooling to recycled pond water and to consume a portion of this water in product manufacture. Various wash water uses which previously depended on a city water source are

being converted to pond recycle water. Water softener regeneration tests using process compatible sodium sulfate instead of non-compatible sodium chloride have shown promising results and are continuing. In the past, all stormwater falling in the vicinity of the alum and SAS plants was captured and added to the pond system. A zero flow balance requires the redesign of spill and process containment areas to minimize captured stormwater and to segregate and protect stormwater which will run off the plant property.

Solids Handling

The new system will include periodic dredging of the settling pond and depositing the solids on a previously used pond adjacent to and immediately west of the settling pond (see Figure 3). For clarification, the previously used pond will be referred to as the "solids pond" whereas the currently used settling pond will be referred to as the "settling pond." Borings completed in the solids pond revealed it has a six feet thick bottom clay layer. Wet conditions found within the pond as well as water pooled in the northeast corner of the pond at the end of a very dry 1983 summer season indicate the solids pond does not leak.

The new operating method will utilize this pond for solids retention while draining leachate and runoff into the settling pond. The existing surface of the solids pond slopes to a low point at the northeast corner (see Figure 1). A culvert will be installed at this low point so that any water accumulating in the solids pond will flow into the settling pond and become part of the process recycle flow. Solids dug from the settling pond will be placed in the solids pond and contoured to maintain no greater than a 1V to 5H slope. A perimeter channel will be maintained around the solids to drain toward the northeast corner culvert (see Figure 2). When final contours are reached, a vegetative cover will be established to stabilize the surface. Hydroseeding is a successful method used to establish vegetative cover at other Allied Chemical alum plants which use the same Missouri Clay raw material. Intermediate erosion control will be maintained by application of a hardening gypsum layer. After completion of final contours and establishment of a vegetative cover, surface runoff is expected to meet water quality standards and will be redirected away from the settling pond to the stormwater collection ditch. The vegetative cover will be periodically monitored and maintained for erosion control.

In order to continue plant operation, the settling pond will require dredging in 1984. Design capacity of the solids pond is approximately 195,100 cubic yards. At the current plant solids production rate of approximately 24,000 cubic yards per year, based on an alum production rate of 35,000 tons per year, the solids pond design capacity will be reached in 8.1 years.

Groundwater Monitoring

Upgradient and downgradient groundwater samples will be collected semi-annually to monitor improvement in groundwater quality. Samples will be collected from PZ-8 (upgradient) and PZ-7 (downgradient) and analyzed for pH, Total Dissolved Solids, and Sulfate (see Figure 3). Additionally, PZ-5 will be sampled semi-annually and analyzed for the same parameters to monitor improvement expected after the process water return ditch is abandoned. The selected parameters are key indicators associated with the manufacturing process and will clearly indicate trends in groundwater quality improvement. EPA approved analytical procedures will be followed. Results will be submitted semi-annually to the Division of Water Pollution Control in Springfield and Collinsville, Illinois.

4/yr first 1-2 years
2/yr after

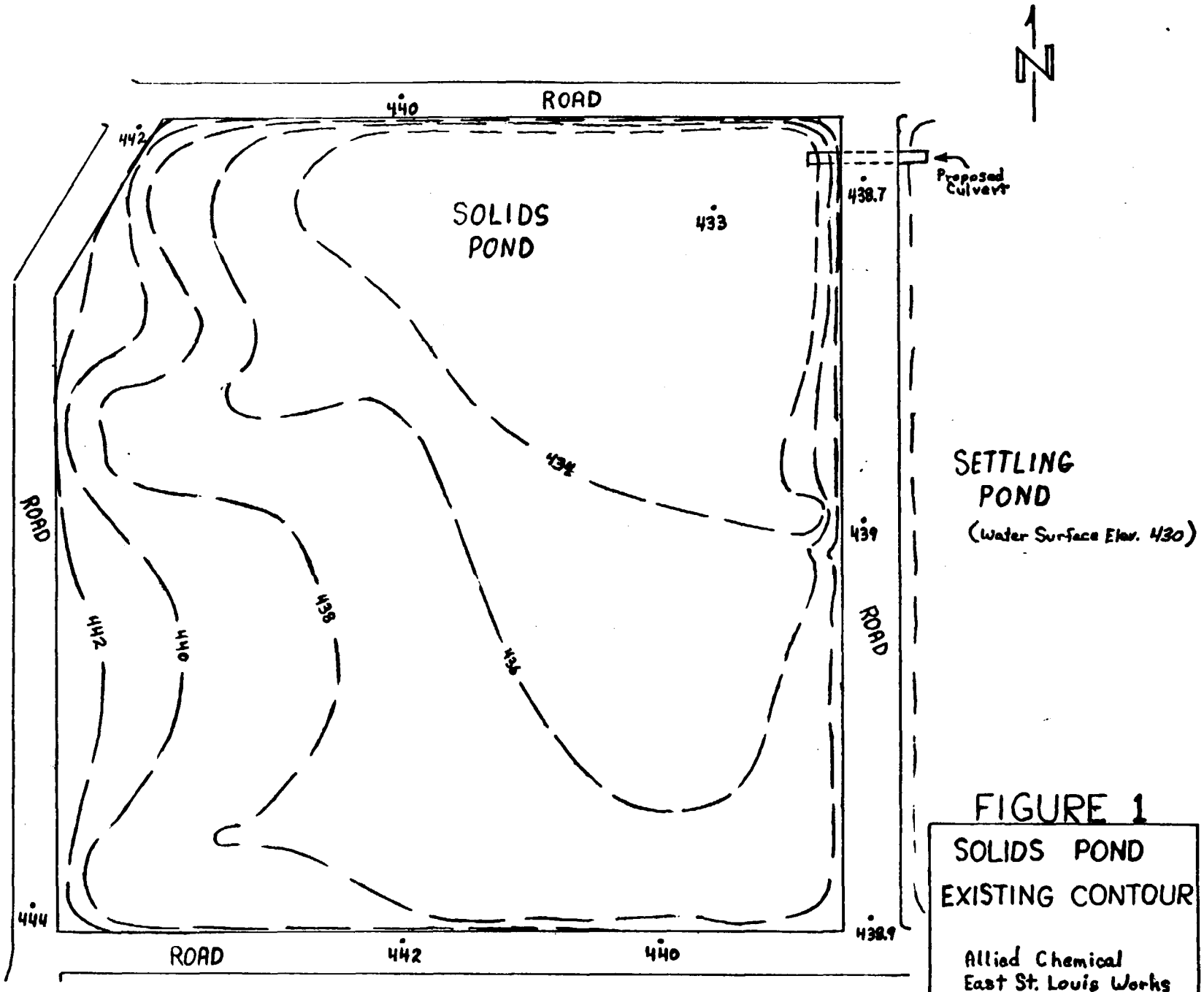


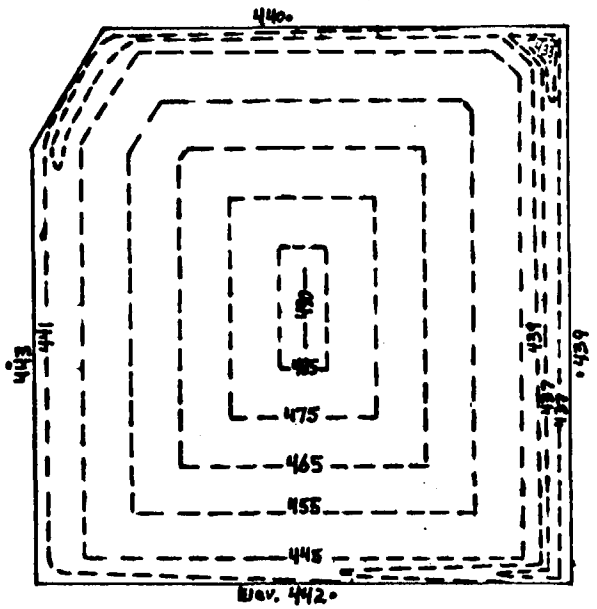
FIGURE 1

SOLIDS POND
EXISTING CONTOUR

Alliad Chemical
East St. Louis Works

100'

2/14/84



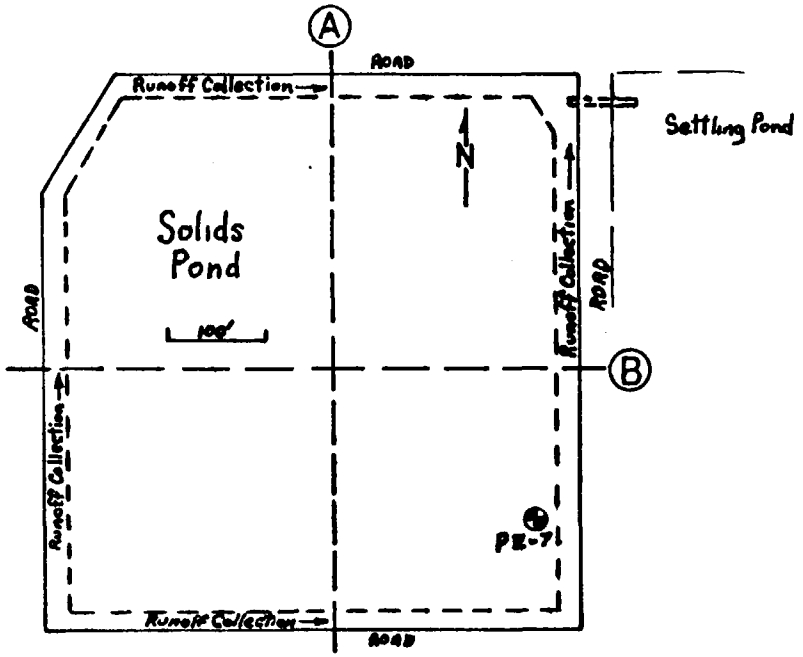
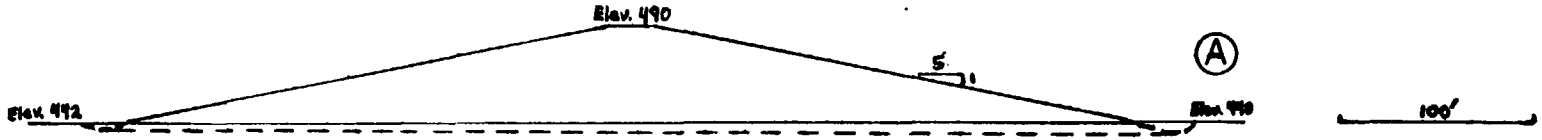


FIGURE 2

SOLIDS POND
FINAL CONTOURS

Allied Chemical
East St. Louis Works
3/84



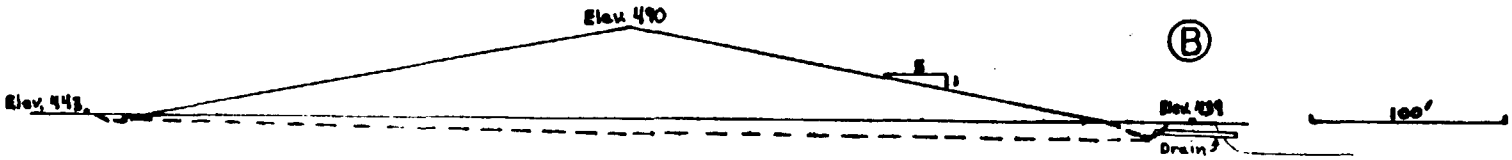
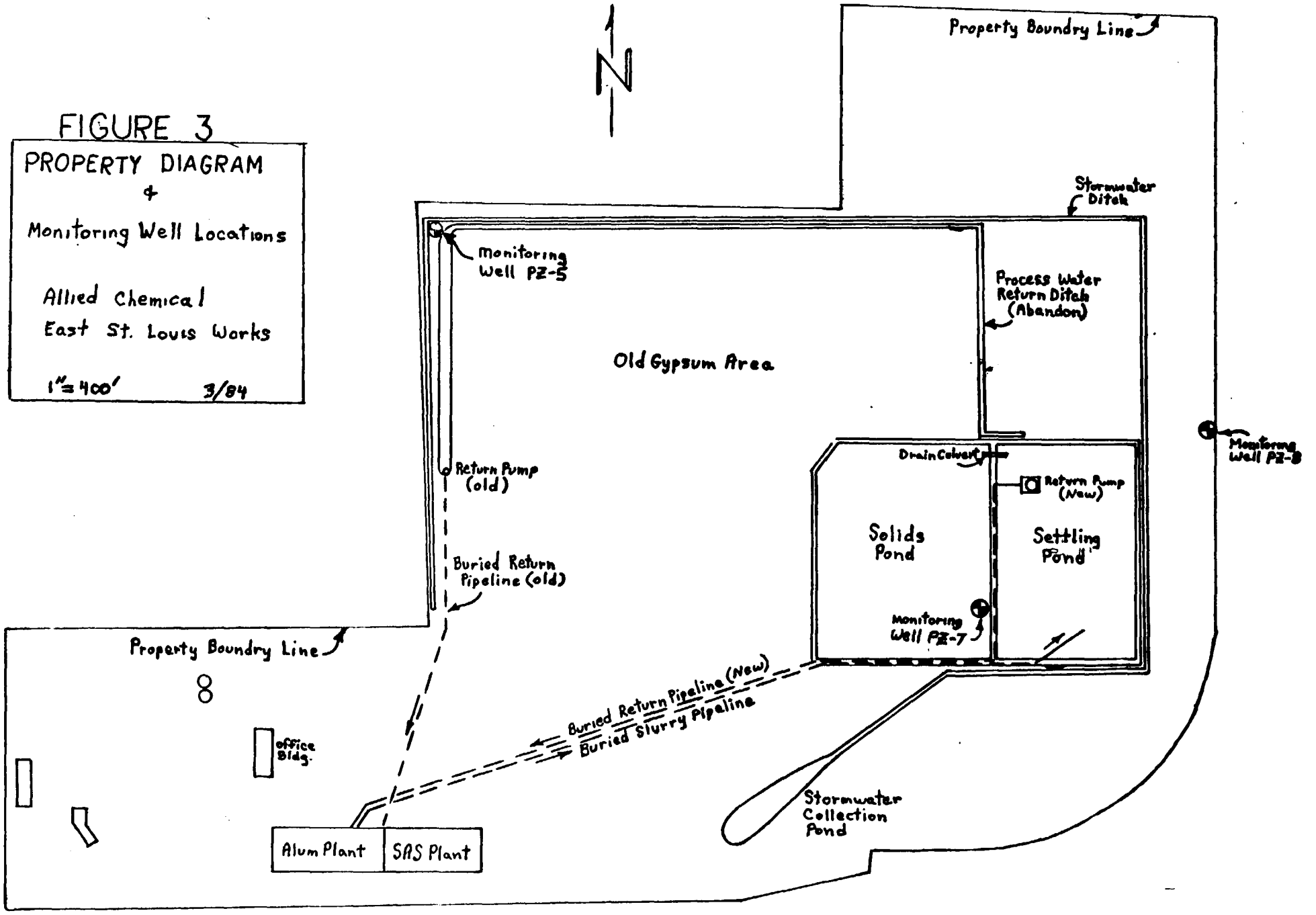


FIGURE 3

PROPERTY DIAGRAM
&
Monitoring Well Locations

Allied Chemical
East St. Louis Works

1"=400' 3/84



Allied Chemical

Rt. 3, Box 26
Harrisburg, IL
62946

~~1699 167th Street~~
~~Suite 35~~
~~Calumet City, Illinois 60409~~

0756-84

RECEIVED

MAR 29 1984

Environmental Protection Agency
Division of Water Pollution Control
Permit Section-Springfield
State of Illinois

March 28, 1984

Mr. Timothy R. Kluge
Industrial Unit, Permit Section
Division of Water Pollution Control
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

Re: Allied Chemical
East St. Louis
Permit No. 1983-EO-1616

Dear Mr. Kluge:

Permit No. 1983-EO-1616 issued July 1, 1983 to Allied Chemical's East St. Louis Works for its Solids Separation Facility contained Special Conditions requiring submittal of an alternate treatment system plan by April 1, 1984. The Plan was discussed with you and Messrs. McSwiggin and Sheth during a February 16, 1984 meeting in Springfield. A written description of that plan is attached. The plan contains elements which satisfy Special Conditions 5(b), 5(c), 5(d) and 5(e).

Special Condition 5(b) requires a proposal to prevent groundwater degradation. Our plan is designed to satisfy that Condition. By eliminating the process water return ditch and containing process water and solids within ponds which upon close examination show no evidence of leaking, prevention of groundwater degradation has been addressed. As required by Special Condition 5(c), the plan describes closure of the Old Lagoon which we call the "solids pond." Final contours and surface stabilization are expected to be completed in 8.1 years. The present lagoon or settling pond will be a continuing part of the operation and its closure is not anticipated in the foreseeable future. The plan proposes semi-annual groundwater monitoring from three wells (Special Condition 5(d)) using key indicator parameters associated with the manufacturing process. Upgradient and downgradient wells will monitor the settling/solids pond area. A third well will monitor improvement in groundwater quality in the process water return ditch area. Special Condition 5(e) requires a plan for an alternate treatment system. Our attached plan describes that system.

Implementation of the plan will require modifications to plant processes, spill containment and stormwater segregating systems in order to assure a zero water flow balance. Testing and feasibility determinations have been in progress for several months, but process modifications must wait until the Illinois EPA approves the operating plan and issues a new permit. Two construction seasons will be required to complete the necessary modifications. If the permit is issued by July 1, 1984 much of the work can be accomplished during the 1984 construction season and all modifications can be completed by September 30, 1985.

The settling pond is expected to be near solids retention capacity by the end of 1984 when our present permit expires. In order to continue plant operation in accordance with the new plan, the pond will require dredging during 1984. Special Condition 3 of our present permit prohibits dredging the pond while the permit is in effect. We therefore ask that our present permit be cancelled and a new permit be issued by July 1, 1984 incorporating the new plan of operation and allowing us to dredge the pond during 1984. Since the solids pond has a 8.1 year design capacity we ask that the new permit not expire before July 31, 1992.

After you have a few days to consider the plan and our request for a new permit, we will call to discuss any questions you may have. If it would be helpful, Don Smith and I would be pleased to meet with you again in Springfield at your convenience. If you would like to discuss any questions by phone, my number is (618) 252-3215.

Yours truly,

S. K. Shogren
Supervisor - Environmental Affairs
Water Treatment Chemicals

cc: D. D. Smith

Allied Chemical

P.O. Box 607
East Saint Louis, Illinois 62202
BRidge 1-2430

April 16, 1984

Mr. Timothy R. Kluge
Industrial Unit, Permit Section
Division of Water Pollution Control
Illinois Environmental Protection Agency
2200 Churchill Road
Springfield, Illinois 62706

Re: Permit No. 1983-EO-1616

Dear Mr. Kluge:

As required by Special Condition 4 of the referenced permit, groundwater samples were collected on March 30, 1984 from wells upgradient and downgradient of the settling pond at Allied Chemical's East St. Louis Works. Wells designated PZ-7 and PZ-8 as described in the January 9, 1984 hydrogeological report were sampled. PZ-5 was also to be sampled, but the sampling pump for that well did not arrive in time. PZ-5 samples will be included in future groundwater monitoring reports.

A local laboratory was contracted to provide collection, treatment, transport and analytical services. This report contains the first results from that laboratory. Differences in parameter concentrations between this report and the hydrogeological report is probably due to a change in laboratories.

The analytical results are as follows:

PARAMETER	PZ-7	PZ-8
pH	6.17	7.10
Sulfate, mg/l	2323	400
Oil & Grease, mg/l	<1	<1
Iron (Dissolved), mg/l	0.16	0.30
Manganese, mg/l	18	0.10
Total Dissolved Solids, mg/l	4277	1060

We trust this report satisfies Special Condition 4.

Sincerely,

S. K. Shogren
Supervisor - Environmental Affairs
Water Treatment Chemicals

cc: R. Schleuger - IEPA, Collinsville